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High Production Machinery

In view of the results accomplished with specialized, high-production machinery in some of the more modern equipped railroad shops no one can doubt the advisability of more generally installing these machines as fast as circumstances and the financial condition of the railroads permit. It is a mistake, however, to recommend the installation of any machine simply because it is modern, powerful and designed for high production. These machines are of necessity more or less expensive and unless there is work enough available to keep them in operation a large proportion of the time, interest and depreciation charges on the investment will more than equal what has been saved by increased production while the machine was in operation. It has always been the policy of the *Railway Mechanical Engineer* to advocate installing labor saving machinery and equipment in railroad shops but only after a detailed study of the situation and careful balancing of cost against possible savings. In the words of a prominent mechanical department officer "modern high-power shop machinery should be selected with extreme care. A time-study should be made of machine operations, and machine tools that cannot produce to the capacity of modern tools, should be abolished or used only in cases of emergency. The higher capacity tools should be operated on two shifts in order to secure a greater production."

No industrial manufacturer would think of ordering new machinery until a careful study had been made of the situation, finding out the exact machinery which will best serve his purpose and determining as accurately as possible what saving may be effected. The time is coming, and in fact is now here, when railroad shops must be managed with the same degree of care and business judgment as is found in any successful business venture. Railroad mechanical officers should study their machine tool requirements as carefully as an industrial manufacturer who must meet competitor's prices. Careful statements can then be prepared, taking into account all contributory factors, balancing costs against possible savings, and showing at a glance whether or not it will pay to install the high production machines in question.

Needs of Smaller Locomotive Terminals

The smaller locomotive terminal and its needs have too often been forgotten or passed by with the thought that the men can continue to worry along somehow at such points with what they have. It is fully as important as at the larger terminals that the arrangement of tracks and the facilities for coaling, taking water and cleaning fires be such that the locomotive can be gotten into the house as promptly as possible if repairs have to be made. Even though repairs may be made out-of-doors, such work is done under difficulties in bad weather and is practically impossible in the winter time in the north. It is too much to expect that good men will continue to work under uncomfortable conditions. In addition, men working by themselves out-of-doors cannot be adequately supervised and it also necessitates expensive movements of men and material. The minor terminal is necessarily at a disadvantage in the equipment of machine tools as compared with the larger points. There is frequently a possibility of improving conditions in this respect by transferring tools that are not sufficiently modern to meet the requirements of the main shops and replacing them by improved modern tools.

Another point of weakness in the minor terminal and one that can be corrected at a small expense is the inadequate equipment of hand tools and in the lack of suitable small tools for the few machine tools which are provided. To obtain

the greatest benefit for such tools they should be taken care of properly and where tool dressing facilities are lacking, as is frequently the case, they should be returned systematically to the main shop for redressing or replacement, as required. A good mechanic who has some ingenuity can do wonders with a hammer, a cold chisel and a file, but it is always done at a far greater expense than if he had been provided with a few conveniences so taken care of that needless time was not wasted in hunting up something to do the job with.

Location and Grouping of Machine Tools

In the consideration of plans for increased production and reductions in the cost of performing work the advantages to be derived from new and improved machine tools is usually given first consideration. While there is undoubtedly a pressing need for new equipment in most railroad shops, the economies that can be obtained by care in the location and grouping of machine tools is a matter that is far too often overlooked. The importance of a consideration of this feature applies not only to the placement of new machines; marked economies in operation and an increase in shop production can frequently be obtained by regrouping existing equipment. In successful manufacturing plants the arrangement of buildings and the layout of machines is made a subject of careful study in order that material from the time it is received at one end of the plant in the form of castings, forgings, sheets, etc., shall move in as direct a route as possible from one operation to the next until it is finally inspected and delivered to the storeroom or shipping department at the other end of the plant.

While few railroad shops are used primarily for manufacturing operations the underlying principles are equally applicable in shops designed and operated for the repair and maintenance of locomotives and cars. In too many shops large and important jobs cannot be performed without moving the work from one point to another and back again before it is finished. Unnecessary movements or movements of unnecessary length are costly, even if suitable cranes and material-handling equipment are available, and they always mean delays. In studying the question of machine location the preparation of routing diagrams for the movements of the more important or more frequently performed operations will often show distinctly the existence of conditions that have been overlooked and will be of the greatest aid in correcting the situation.

New Lease of Life for Weak Cars

Wooden cars with weak draft sills have been a seriously disturbing factor in railroad operation for many years. They are the cause of numerous wrecks and accidents, they require excessive maintenance expenditures and frequent transfers of lading and they are a fruitful source of claims for loss and damage to freight. For seven years the desirability of keeping them out of interchange has been discussed before the Master Car Builders' Association and its successor, the Mechanical Division of the American Railway Association. The adoption by letter ballot in 1914 of a provision in Rule 3 of the Interchange Rules to the effect that cars of less than 60,000 lb. capacity be not accepted in interchange after October 1, 1916, is ample proof that the desirability of eliminating these cars was widely recognized. And yet the effective date of this provision has been advanced from year to year and these cars are still running in interchange. As the rule now stands the time limit is October 1, 1922, but in this year's report the Arbitration Committee recommends a further extension to October 1, 1923. There is no lack of appreciation of the common interest of the railroads to improve equipment conditions, but the record suggests that no concerted action toward that end can be accomplished so long as this common interest does not appear to be entirely in harmony with the immediate interests of the individual roads. So long as the railroads are privately owned and operated this condition will continue.

This situation suggests that the incentive of individual interest be recognized and that advantage of it be taken in the Interchange Rules to bring about improvements in equipment conditions which direct appeals to the common interest have failed, and will continue to fail, to effect. The present prices for labor and materials fixed by the Interchange Rules on a bare cost basis offer little inducement for the proper maintenance of foreign cars and are demoralizing in their effects upon car owners as well. Certainly, a code of prices which compels the handling line to make repairs at cost is not likely to foster the keenest sense of responsibility for the care of its own equipment on the part of the owner. Neither is the handling line likely to keep foreign cars out of service for more than the minimum of repairs required for actual movement, while in the meantime it must donate to the owner the use of the car at the rate of a dollar a day. A scale of prices for labor and material properly adjusted to include an average profit of not less than 10 per cent not only would stimulate the interest of the handling line in foreign equipment but would bring directly home to the owning line its responsibility to keep its equipment in condition to meet the requirements of modern railroading. The final disappearance of the weak equipment which has so long been a troublesome factor in the problem of efficient operation would be hastened and the general standards of construction and maintenance would be elevated.

Is Piece Work the Issue?

Statements presented by the railroads before the Labor Board early in the year showed decreases in productive efficiency of railway shop employees ranging from 10 per cent to 50 per cent following the abolition of piece work by the Railroad Administration in 1918. The railroads maintain that these reductions were the direct result of the distortion of the guaranteed minimum hourly rate in relation to the piece work rate, finally followed by the complete abolition of piece work. Accepting as facts the reductions in output as measured by the average hourly earnings at piece work rates, the Railway Employees' Department of the American Federation of Labor in its exhibit recently presented, contended in rebuttal that these decreases are merely reflections of increases in the number of men employed, attributable in part to the increasing difficulty of promptly supplying needed tools and materials as the number of men employed increases, thus creating a handicap on output which is reflected in decreased average hourly piece work earnings.

In its direct attacks on the piece work system, the Railway Employees' Department maintains, first, that the varying amounts of skill and effort required in repeated performances of the same operation or combination of operations in a repair shop is so great that piece work rates cannot be established with accuracy or strictly adhered to in practice, and second, that the unit costs of locomotive maintenance of a group of roads in the Alleghany region working under piece work schedules are consistently greater than the unit cost of a group of railroads in the Northwestern region working on a time work basis. Little weight need be given to the latter contention since it is obviously impossible to make accurate comparisons between individual railroads or groups of railroads, because the results will be affected by differences in the type of power, in climatic conditions, in the quality and quantity of repair shop facilities, and in the character of the feed water supply as well as differences in the topography of the lines.

There are undoubtedly many operations in a repair shop for which satisfactory piece work rates cannot be established;

on the other hand there are operations the performance of which is well adapted to payment on a piece work basis. Some piece work schedules may contain numerous inconsistencies, owing to an effort to establish prices on operations the performance of which cannot be standardized. Other more limited schedules may be developed which are not open to this objection. Can a principle, the fundamental correctness of which has not been attacked even by the Railway Employees' Department, be condemned because its application and administration has not been perfect? Is not the adoption or rejection of piece work a matter which may properly be left for settlement by negotiations between local representatives of the employees and the managements? It is extremely doubtful if its adoption can be prevented in any shop where it proves to be mutually agreeable to the management and the men.

The real issue is not piece work; it is this: Are we to have nationalized management of the railroad shops by the American Federation of Labor through the instrumentality of the United States Railway Labor Board, or are we to have private management of railroad shops, along with the rest of the railroads, in accordance with the Transportation Act, with the Labor Board serving as a tribunal of justice to facilitate and not to hamper the efficient operation of the properties? Until that question has been settled the piece work controversy is not of first importance.

Main Rod Repairs

While the rod department occupies a relatively small proportion of the total floor space in a railroad shop and employs comparatively few men, it is an important department and in many cases under present conditions limits the output of the shop. No railroad repair shop can handle locomotives faster than it can repair the rods needed for those locomotives. In addition to caring for engines undergoing general repairs, the rod department is often expected to provide rods for locomotives needing light repairs and others held out of service at roundhouses for rod work. This outside work is a most disturbing feature as it entirely upsets the shop schedule to have a set of rods come in requiring practically general repairs that must be completed ahead of rods needed for outgoing locomotives. The fact remains, however, that this condition does exist and the rod department must have sufficient reserve capacity to make all repairs promptly.

Perhaps one of the best ways to increase the capacity of the rod department is by eliminating as far as possible hand filing and fitting of main rod front and back end brasses. A timely article on this subject, showing the machinery and methods needed for the work, is published elsewhere in this issue under the title of "Speeding Up Locomotive Main Rod Repairs." The author has gone into the subject in considerable detail and without anticipating too many of his conclusions it may not be amiss to say that the use of a rugged surface grinder for truing the sides of the rods and a high-power milling machine for truing and squaring the rod jaws will do much to increase the accuracy of main rod repairs and assist materially in reducing hand work.

In machining back end brasses the use of an indexing fixture to machine one pair of brasses at a time is recommended. This work is usually done on a milling machine, crank planer or shaper. "With a well-made indexing fixture," says the author, "brasses are machined in some shops so accurately that they are a satisfactory fit in the rod, and no filing is necessary except to remove burrs." The use of micrometer calipers is essential and increases the accuracy of the work, being a great improvement over fit-and-try methods.

Attention is directed to the fact that the question of milling versus shaping brasses from the rough castings will be dependent largely upon the quality of brass or bronze used. In some cases there is no doubt that the difficulty and cost of keeping milling cutters sharp when machining brass castings with hard outside scale has far more than offset any saving due to the substitution of milling for shaping operations. Special fixtures for holding front end main rod brasses while being machined are illustrated and described in the article which advocates the use of milling machines wherever the quality of the brass or bronze warrants. The closing paragraph of the article is an able summary of arguments for and against machine fitting of main rod brasses, the conclusion being strongly in favor of machine fitting because of greater accuracy in the work and reduced labor cost.

Material-Handling Devices and Shop Layout

The function and importance of material-handling equipment in connecting one machine with another should always be kept in mind. From the time work is started until it is finished and delivered to the erecting shop or roundhouse it must be moved from one machine or point to another as conditions require. While much can and should be done to reduce such movements to a minimum, consideration should be given to the means by which necessary movements of material are performed. Where more than one method is available, a proper selection may expedite the movement and reduce its cost, for every movement means an added cost. Even where crane service has been provided for, delays in waiting for a crane and the high cost of crane operation may render an overhead track system equipped with suitable electric or pneumatic hoists an economical addition. Aisles should be suitably arranged and kept free from obstruction so that they can be used for the rapid movement of materials by industrial cars or by industrial trucks which are the most economical equipment for moving materials a considerable distance. For the loading and unloading of such trucks and cars and for moving material to and onto the larger machines an overhead track and hoist can frequently be used as a substitute for or supplementary to a crane. Another simple device which is being increasingly used in manufacturing shops and which might sometimes be used to advantage in railroad shops for transferring work from one machine to another nearby machine is a section of gravity roller conveyor. In plans for the layout of tools in a shop, both the movement of material and the means to be used should thus be given consideration. The field in which the largest benefits can be realized on most roads is in the older and smaller shops which have not hitherto been provided with the material-handling devices which are commonly found in the larger modern shops.

Stop Waste of Fuel at the Source

On the majority of roads the mechanical department is held responsible for fuel economy, principally because the condition of locomotives and the manner of handling them is the biggest single factor in the economical or wasteful use of the fuel. It follows that everyone having to do with the maintenance or operation of the power has a direct responsibility for fuel economy. In practice, however, the road foremen of engines are usually held chiefly responsible for the fuel performance. Shops and roundhouses are likely to consider it a secondary matter except when a special drive for fuel economy is being made by the road. The supervision exercised by the traveling engineer is not sufficient to locate even the important defects that waste fuel, because most roads employ only one traveling engineer for each fifty to eighty locomotives and fuel supervision is only one of his duties.

To insure the best results the roundhouse forces must be organized to stop the waste of fuel at the source by correcting conditions that make locomotives uneconomical. It should not be necessary to wait until the locomotive uses such an ex-

cessive amount of coal that it becomes noticeable to the crew before mechanical defects are corrected. A thorough periodical inspection will disclose the defects and by making repairs promptly a great deal of waste will be avoided. It should be said in justice to roundhouse men that the majority of them do not need much instruction in keeping locomotives in economical operating condition but they do need supervision to see that other duties do not cause them to overlook some of the simple things that are the very essentials of fuel economy. The engine inspectors can be depended upon to notice a loose bolt or a tire flange that is cutting, but leaky steam pipes, cylinders and valve packing or valves incorrectly set are not so easily found and unless special care is taken they are likely to be passed by. Too often the important matter of keeping sufficient air openings in grates and cleaning tubes and flues is considered as just a dirty job to be finished as quickly as possible, and the lack of attention results in loss of heating service and low superheat with a corresponding increase of fuel consumption. Such examples could be multiplied, for, as stated before, fuel economy is a matter that concerns every employee. When the shops and roundhouses are organized to insure that these matters receive such persistent attention that the proper practice becomes a habit, a big step will have been taken in securing economy in the use of fuel.

COMMUNICATIONS

Rusting of Steel Containing Copper

PITTSBURGH, PA.

TO THE EDITOR:

In the May, 1921, issue of the *Railway Mechanical Engineer,* page 291, there appeared an article entitled "The Rusting of Steel Containing Copper," which was a brief abstract of an article by Professor O. Bauer of Berlin which appeared in Stahl und Eisen of January 13 and 20, 1921.

It is unfortunate that the abstractor in quoting the chemical analyses of the sheets used by Professor Bauer did not mention the copper content as given in Tables 2 and 5 in the original article. By referring to the above mentioned tables, it will be found that the steel to which Professor Bauer added amounts of copper up to 0.35 per cent already contained approximately 0.10 per cent copper. He was, therefore, adding copper to a steel already containing nearly, if not quite sufficient copper, to give the maximum corrosion resistance. Numerous corrosion tests made by the writer and others have shown little difference between steels containing 0.10 per cent and 0.25 per cent copper, whereas comparing steels with only a slight trace of copper with steel containing 0.25 per cent of this element, a very marked superiority is found for the latter under all conditions of atmospheric corrosion.

The American Society for Testing M^terials, through their Committee A-5 on Corrosion, started a series of tests in 1916 in three different characters of atmosphere, namely, in the industrial air of Pittsburgh, Pa., the pure air of an inland district at Fort Sheridan, Ill., and salt air, such as occurs at Annapolis, Md. The results of this test have been given in the annual reports of the society, beginning with 1918, and I quote from the 1921 report:

"The results of the observations at the Pittsburgh tests have now reached a point where we may definitely conclude that copper-bearing metal shows marked superiority in rust resisting properties as compared to non-copper-bearing metal of substantially the same general composition, from which superiority we may truly anticipate a marked increase in the service life for copper-bearing metals under atmospheric exposure of uncoated sheets.

"It is interesting to note in this connection that the lighter gage non-copper-bearing Bessemer and open hearth metals, which failed first at Pittsburgh, have also failed first at Fort Sheridan, which would indicate that the two different atmospheric conditions have shown substantially the same general tendencies, only with varying rates of corrosion."

The accompanying table, which is also copied from the official report of Committee A-5, indicates the comparative life of copper-bearing and non-copper-bearing sheets.

FAILURES OF COPPER-BEARING AND NON-COPPER-BEARING SHEETS, A. S. T. M. CORROSION TESTS

Type Designation	Gage	Number of groups	Total number of sheets	Number failed	Total failures at each inspection, expressed as percentages of total sheets of each type exposed: 10 Mo.	16 Mo.	22 Mo.	28 Mo.	35 Mo.	41 Mo.	46 Mo.	52 Mo.
Copper-Bearing.....	16	14	132	None	.....	.....	.....	.....	.....	.....	.....	.....
Non-Copper-Bearing.	16	11	126	54	None	None	None	10.3	15.9	26.2	32.6	42.9
Copper-Bearing.....	22	15	146	93	None	None	1.4	4.1	13.7	27.4	44.5	63.7
Non-Copper-Bearing.	22	11	84	82	None	35.7	79.7	91.6	94.0	96.4	96.4	97.6

That a copper content of 0.10 per cent has material influence on the corrosion rate, in fact that that amount is nearly as good as 0.25 per cent, is shown in a paper presented by the writer at the 1919 meeting of the American Society for Testing Materials, entitled "The Influence of Very Low Percentages of Copper in Retarding the Corrosion of Steel." In this article it is shown from exhaustive tests, under atmospheric conditions, that in a low sulphur heat (0.031 per cent sulphur), 0.08 per cent copper is sufficient to give the maximum corrosion resistance, and in the higher sulphur heat (0.055 per cent sulphur), 0.10 per cent copper gives very nearly the maximum benefit.

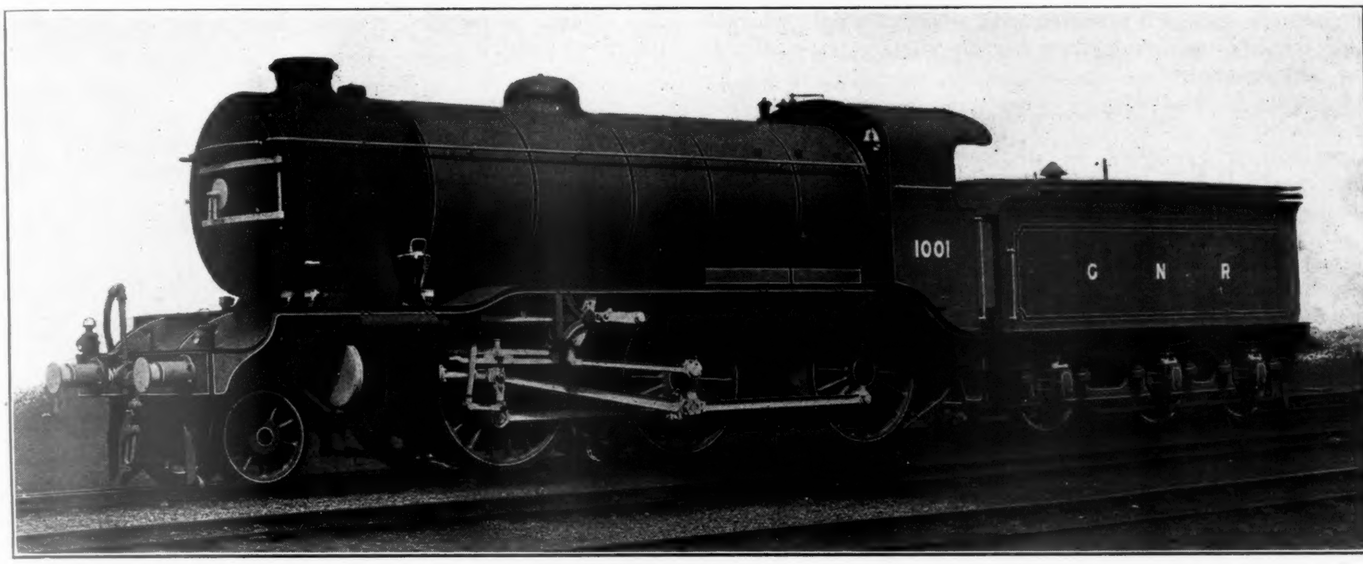
From the tests above mentioned, it is not unreasonable to conclude that had Professor Bauer started with a steel containing none or only the usual slight trace of copper, his results and conclusions would have been entirely different, and would have confirmed the test made by the American Society for Testing Materials.

D. M. BUCK,
Metallurgical Engineer, American Sheet & Tin Plate Co.

NEW BOOKS

Saward's Annual Statistical Review of the Coal Trade. 254 *pages, including advertising, 6 in. by 8 in. Published by Frederick W. Saward, 15 Park Row, New York.*

To men who are connected with the purchase or use of coal, a compilation of data regarding the operation of previous years is of value. This book provides information not otherwise readily available, giving in very complete form statistics of production and shipment with considerable information pertaining to the consumption of fuel. Sufficient comment on conditions in the industry are given to aid in interpreting the figures presented. The situation existing in 1920 is reviewed for the country as a whole and also for the principal producing districts and market centers. Production of both anthracite and bituminous is given for many of the principal companies, as well as for the various fields and for all the states. A large amount of data regarding prices is given, including quotations as early as 1834. The wage rates and the texts of the wage awards for both bituminous and anthracite are quoted. The tonnage shipped over various railroads is given, as well as the amount carried by water, the receipt at the lakes and the amount exported. In addition to the data regarding coal, figures are given for the production and consumption of petroleum.



Great Northern Railway Three-Cylinder Type Locomotive for Fast Freight Service, Designed by H. N. Gresley, Locomotive Engineer, Built 1920, Doncaster Shops

The Comparison of Dimensions and Proportions of British Locomotives

BY E. C. POULTNEY

THE writer has dealt previously with British locomotive practice in the columns of the *Railway Mechanical Engineer,* and the present article supplements the information already given, and at the same time offers a few notes on the general subject of the comparison of locomotive dimensions. The latter part of the subject will be taken first, and in conclusion some brief reference will be made to British practice as exemplified by the various designs embodied in the tables of dimensions which accompany this essay.

Discussing in the first place the various factors which are required in order that one locomotive may be compared with another, it is suggested that the following may be satisfactory, each being designated by the symbol used.

Factors

Factor of Adhesion, A

$$A = \frac{\text{Adhesive Weight}}{\text{Rated Tractive Effort}}$$

This is of course simply the ratio of proportion between the average force tending to rotate the driving wheels and the weight or force by which the driving wheels are pressed on to the rails.

Generally it is considered that the rated tractive effort at the rim of the drivers should be not greater than one-fourth of the weight tending to press the wheels on the rail; or, in other words, the factor of adhesion should be 4. The above holds good when the rails are clean and dry, and under reverse conditions considerably more weight is necessary to prevent slipping, hence a factor of 4 should be taken as a minimum figure in order that the locomotive should not, under average weather conditions, be excessively "slippery" at starting. For locomotives employed in working local passenger trains making frequent stops and which have to get into speed quickly after starting, it is undoubtedly advantageous to increase the weight available for adhesion relatively to the maximum average tractive effort so as to minimize the chances of slipping, and the same applies to engines to be used for shunting or switching operations. For locomotives used generally in "through" services, that is making fairly long runs without stops where rapid acceleration has not the same need for consideration, a factor of 4 will usually be sufficient, because the natural reduction in tractive force as the speed increases will counteract any tendency to slip. Table I which gives particulars of the adhesive factor of modern superheated locomotives brings the characteristics of the different types into prominence.

It will be noted that all but one of the 14 types of engines mentioned have a ratio of over 4 as the average value for the factor A. The 4-4-0 type engines have a factor of 4.25 while with the 4-4-2 engines there is a tendency to use a factor of lower value due to their larger boilers making the use of greater cylinder capacity possible.

TABLE I

VALUES OF THE ADHESIVE FACTOR, A; MODERN SUPERHEATED LOCOMOTIVES

Engine type		Maximum	Minimum	Average	Reference
4-4-0	Tender engines	5.86	4.02	4.25	Table 1
4-4-2	Tender engines	4.6	3.8	4.2	" 2
4-4-2	Tank engines	4.3	4.1	4.2	" 2
4-4-4	Tank engines	4.7	4.3	4.5	" 2A
4-6-0	Tender engines	6.2	4.3	5.1	" 3
2-6-0	Tender engines	5.3	4.3	4.2	" 6
0-6-0	Tender engines	5.2	3.7	4.5	" 7
4-6-2	Tender engines	...	...	4.8	" 8
4-6-2	Tank engines	6.2	4.3	5.4	" 8
4-6-4	Tank engines	...	...	5.2	" 10
2-6-4	Tank engines	7.3	4.9	6.1	" 9
2-8-0	Tender engines	5.1	3.3	4.4	" 4
0-8-0	Tender engines	5.2	4.3	4.7	" 5
0-10-0	Tender engines	...	...	3.8	" 4A

The six coupled locomotives of the 4-6-0 type have boilers of about the same size as those of the Atlantics, but can have 50 per cent more adhesive weight, and the value of A is therefore greater. If the cylinders were larger so as to absorb a greater percentage of the weight available for adhesion, then they would be too large in proportion to the heating surfaces for express services. This will be appreciated on comparing the Boiler Factors of the 4-4-2 and 4-6-0 engines.

Tank engines of the six coupled type and the 0-8-0 tender

engines are both well provided with adhesive weight which is more readily obtainable than heating surface, especially in the tank locomotives.

Rated Tractive Effort, R T E

$$\text{R. T. E} = \frac{d^2 \times s \times P \times 0.85}{D}$$

The usual formula for calculating the Rated Tractive Effort is used as above, the symbols employed have values corresponding with those in the columns of the tables of dimensions. Thus *d* and *s* indicate the diameter and stroke of the pistons, and *D* the diameter of the driving wheels, and *P* the boiler pressure. The mean effective pressure is assumed to be equal to 85 per cent of the boiler working pressure *P*. In his excellent report on express locomotives read before the International Railway Congress in London in 1895. J. A. F. Aspinall used 70 per cent ($P \times 0.7$) for the average pressure, and the late S. W. Johnson in his presidential address to the Institution of Mechanical Engineers in 1898 used a mean effective pressure equal to 75 per cent in calculating the maximum tractive effort. However, while there appears no strict uniformity it now seems that 85 per cent is a figure quite generally adopted, and as the writer has always used this value it is for these reasons adopted for the purpose of the present article.

TABLE II

AVERAGE VALUES OF BOILER FACTORS *B* AND *BD* AND COMBUSTION FACTOR *C* AND DRIVING WHEEL DIAMETER *D* FOR MAIN LINE TENDER ENGINES FROM TABLE III

Engine type	B	BD	C	D
4-4-0	14.2	1216	72.1	81
4-4-2	11.1	904	78.7	80
4-6-0	13.6	1047	78.6	77
2-6-0	17.0	1099	72.4	66
2-8-0	19.1	1004	80.0	60
0-8-0	19.7	1090	81.1	53
0-6-0	20.9	1001	71.0	60

Boiler Factor, B

$$B = \frac{\text{Rated Tractive Effort}}{\text{Total Heating Surface (evaporative)}}$$

This factor indicates the amount in pounds of tractive effort to be supplied by each square foot of heating surface when the engine is running in full gear. In comparing two locomotives having different boiler factors and running at the same speed in miles per hour, the horse power to be furnished per square foot of evaporative heating surface will be measured by the respective values of B calculated as above.

Boiler Demand Factor, B D

$$\text{B.D.} = \frac{\text{Rated Tractive Effort} \times \text{Driving Wheel Diameter}}{\text{Total Heating Surface (evaporative)}}$$

The boiler demand factor as above expresses the horsepower to be developed per square foot of heating surface when the speeds in revolutions per minute are the same, it being assumed that the diameter of the driving wheels is proportional to the speeds in miles per hour at which the locomotives are intended to most usually operate. The general idea underlying the choice of both the factors *B* and *BD* was delineated by Lawford H. Fry writing in "The Engineer" of Oct. 13, 1911, and again in the *Railway Mechanical Engineer* of April, 1921, and therefore need not be repeated.

If two locomotives are both developing the same percentage of their rated tractive effort, and both traveling at the same speed in miles per hour, then the power required per square foot of heating surface is measured by the respective values of *B*; and again, if the speeds in revolutions per minute be the same, then the power to be developed by each square foot

TABLE III

BOILER AND COMBUSTION FACTORS OF SELECTED EXAMPLES FROM TABLES 1 TO 7, INCLUSIVE; SUPERHEATED LOCOMOTIVES FOR MAIN LINE SERVICE

Railway	R.T.E.	D	B	BD	C
4-4-0 Type					
L. N. W.	20,000	81	12.9	1,045	82.6
G. C. R.	19,800	81	11.9	980	72.0
N. E. R.	15,600	82	14.7	1,210	53.7
L. C. D. S. E.	19,100	80	13.5	1,080	76.5
C. R.	21,432	78	16.2	1,260	74.0
N. B.	20,400	78	15.9	1,239	75.0
G. W. R.	20,600	80½	13.9	1,112	82.4
L. & Y.	18,300	87	20.6	1,795	58.4
M. R.	17,200	84½	14.7	1,240	70.3
	......	81	14.2	1,216	72.1
4-4-2 Type					
N. E. R.	19,161	82	13.0	1,063	74.0
G. N. R.	17,300	80	8.5	690	83.6
L. B. S. C.	20,800	79½	10.2	815	80.5
N. B.	23,400	81	12.8	1,051	76.7
	......	80	11.1	904	78.7
4-6-0 Type					
L. N. W. R.	23.800	81	13.6	1,093	69.8
G. C. R.	24,772	81	12.1	980	92.0
G. W. R.	25,100	80½	13.6	1,095	78.7
G. S. W. R. I.	18,900	79	10.6	845	78.0
L. S. W. R.	25,200	79	13.4	1,060	73.0
G. E. R.	22,000	78	13.5	1,057	73.8
L. N. W. R.	21,000	75	13.3	1,000	73.5
L. & Y.	29,000	75	14.5	1,120	94.5
N. E. R.	30,032	68	19.1	1,300	77.5
C. R.	21,155	73	12.6	922	75.7
	......	78	13.6	1,047	78.6

Railway	R.T.E.	D	B	BD	C
2-6-0 Type					
G. N. R.	30,000	68	15.7	1,055	82.3
L. B. S. C.	25,800	66	19.9	1,315	63.5
G. S. W. R.	23,700	60	15.9	953	65.0
G. W. R.	25,700	68	17.4	1,183	82.5
S. E. C. D. R.	25,700	66	16.8	1,112	69.3
C. R.	19,424	60	16.3	981	72.0
	......	66	17.0	1,099	72.4
2-8-0 Type					
G. N. R.	32,600	56	15.6	880	91.6
G. C. R.	31,324	56	17.2	827	81.7
G. W. R.	35,200	55½	19.1	1,060	79.0
S. D. J. R.	36,360	55½	27.4	1,525	59.0
G. W. R.	30,600	68	16.6	1,129	80.0
	......	58	19.1	1,004	80.2
0-8-0 Type					
N. E. R.	39,960	55¼	23.4	1,295	77.5
L. N. W. R.	27,800	53½	15.6	840	91.0
L. & Y.	34,000	54	16.4	890	96.0
G. N. R.	27,700	56	23.8	1,335	60.0
	......	54	19.7	1,090	81.1
0-6-0 Type					
G. E. R.	29,044	59	17.8	1,048	69.2
M. R.	22,490	63	19.2	1,210	70.7
H. & B.	22,600	60	20.5	1,232	72.6
L. & Y.	26,500	61	30.4	1,860	57.6
N. B.	23,300	60	16.6	995	87.5
N. E. R.	21,412	55¼	24.9	1,377	66.3
G. C. R.	21,620	62	17.2	990	73.2
	......	60	20.9	1,001	71.0

NOTE.—The following are the complete names of the railways indicated by abbreviations in the tables:

C. R. ....Caledonian.
F. R. ....Furness.
G. C. R. ....Great Central.
G. E. R. ....Great Eastern.
G. N. R. ....Great Northern.
G. S. W. R. ....Glasgow & South Western.
G. S. W. R. I. ....Great Southern & Western (Ireland).
G. W. R. ....Great Western.
H. & B. ....Hull & Barnsley.
L. B. S. C. ....London Brighton & South Coast.
L. C. D. S. E. ....South Eastern & Chatham.
L. & N. W. R. .....London & North Western.
L. S. W. R. ....London & South Western.
L. & Y. ....Lancashire & Yorkshire.
M. R. ....Midland.
Met. R. ....Metropolitan.
N. B. R. ....North British.
N. E. R. ....North Eastern.
N. S. R. ....North Staffordshire.
S. D. J. R. ....Somerset & Dorset Joint.
S. E. C. D. R. ....South Eastern & Chatham.
S. E. C. R. ....South Eastern & Chatham.

of heating surface will be measured by the respective values of *BD*. If two engines have driving wheels of equal diameters then at the same speed in miles per hour the revolutions per minute will be equal, and it is evident that they will show the same relationship whether compared by the factor *B* or *BD*. When, however, it is desired to compare locomotives of the same type but having driving wheels of different diameters and intended to work at different speeds in miles per hour, but making an equal number of revolutions per minute, then the factor *BD* expresses the relation between the respective power demands made per square foot of heating surface. The percentage of the maximum tractive effort engines can exert will depend more directly on the revolutions made per minute than on the speed in miles per hour, for this reason the factor *BD* is usually the better value for comparative purposes, and has therefore been chosen for inclusion in the tables of proportions.

The supplementary Table II has, however, been prepared which presents a comparison of the factors *B*, *BD* and *C* for the average speeds in revolutions per minute that locomotives should make under average conditions of service. The 4-4-0 type express locomotives appear in comparison with other engines to be deficient in heating surface; on the other hand, from a study of the heating surface distribution and the amount of grate area allowed per square foot of heating surface, it seems probable that the evaporation per square foot of heating surface will be relatively greater than with the other locomotives. The most generous allowance of heating surface in relation to the tractive effort is found as would be expected in the Atlantic type, as with this design heating surface is more readily attainable than adhesive weight.

Factor of Combustion, C

The value of this factor is of considerable importance as on it depends in a large measure the steaming capacity and economic performance of the boiler.

For a saturated steam locomotive the combustion factor is the total heating surface divided by the grate area.

TABLE IV

PROPORTIONS OF TYPICAL LOCOMOTIVES, USING SATURATED STEAM, FOR EXPRESS PASSENGER AND FREIGHT TRAFFIC

4-4-0 *Type*

Railway	R. T. E.	D	B	BD	FBS / St.	C	A	E
L. & Y.	14,800	87	12.2	1,061	8.9	64.8	4.6	82.6
M. R.	17,200	84	12.1	1,020	8.9	66.9	4.4	79.7
M. R.	19,200	81	12.6	1,020	9.5	61.0	4.1	77.0
L. N. W.	17,200	81	8.7	708	8.2	87.5	4.9	67.5
N. E. R.	22,000	82	12.7	1,039	9.0	64.3	4.2	74.3
G. W. R.	17,800	80½	9.8	778	6.8	88.5	4.3	66.4
C. R.	18,430	78	11.4	890	9.0	76.8	4.3	76.9
S. E. C. D. R.	18,900	78	12.3	962	8.9	72.1	4.0	76.6
F. R.	14,700	78	11.5	786	6.3	70.5	...	76.6
	......	..	11.4	918	8.5	72.5	4.3	75.3

4-4-2 *Type*

Railway	R. T. E.	D	B	BD	FBS / St.	C	A	E
G. N. R.	15,800	79½	10.9	870	...	55.5	4.4	90.0
L. B. S. C.	19,000	79½	7.6	618	*5.5	79.4	4.4	61.2
G. N. R.	15,800	79½	6.3	503	*5.6	81.0	5.1	58.7
N. E. R.	23,200	82	9.4	775	7.3	90.8	3.7	65.8
G. C. R.	18,680	81	9.7	693	6.9	73.5	4.4	80.0
L. & Y.	16,030	87	8.3	720	8.3	84.2	4.8	64.3
N. B. R.	23,400	81	10.4	840	8.2	79.2	3.8	73.5
	......	..	8.6	717	6.9	77.7	4.3	67.2

*Wide fire-box. †Four cylinders 14¼ in. by 26 in. simple expansion.

0-6-0 *Type*

Railway	R. T. E.	D	B	BD	FBS / St.	C	A	E
C. R.	21,430	60	14.8	887	8.1	72.5	5.1	76.0
C. R.	20,200	60	14.5	870	8.4	67.9	4.7	71.4
M. R.	20,930	63	14.6	925	...	67.0	5.1	68.4
L. & Y.	21,200	61	17.5	1,070	8.9	64.4	4.3	77.9
S. E. C. R.	17,900	60	15.7	973	...	64.9	4.2	70.7
G. N. R.	19,900	58	15.9	1,082	9.6	65.8	5.2	83.0
F. R.	19,200	56	16.9	950	9.2	54.5	4.4	75.2
L. N. W. R.	15,500	60	14.3	857	9.5	63.4	5.0	86.0
M. R.	17,300	62½	13.8	865	8.8	71.4	5.0	76.5
G. N. R.	18,800	61½	16.7	1,027	9.2	63.2	4.6	76.4
	......	..	15.5	980	8.9	64.8	4.7	76.2

4-6-0 *Type*

Railway	R. T. E.	D	B	BD	FBS / St.	C	A	E
G. W. R.	25,200†	80½	11.7	945	7.2	79.0	5.2	80.1
G. W. R.	23,100	80½	10.7	866	7.2	79.0	5.2	73.0
N. E. R.	22,050	80¼	12.4	1,030	7.4	76.8	5.2	85.1
L. N. W. R.	18,600	75	9.3	682	6.7	79.8	5.8	73.2
L. N. W R.	23,600	62½	11.8	743	6.7	79.4	4.1	71.0
G. S. W. R.	20,600	78	11.1	864	7.5	69.0	5.6	81.7
L. S. W. R.	26,200	72	11.9	862	7.6	73.0	5.0	81.0
L. & Y.	27,150	75	10.8	812	7.6	92.0	4.8	68.9
C. R.	20,200	78	8.9	696	6.5	87.0	6.0	73.3
	......	..	10.9	833	7.1	79.4	5.2	76.3

0-8-0 *Type*

Railway	R. T. E.	D	B	BD	FBS / St.	C	A	E
G. C. R.	28,600	53	16.2	860	...	71.0	4.9	80.2
C. R.	28,820	54	11.5	623	...	108.0	4.8	56.0
G. N. R.	26,850	56	18.7	1,069	9.2	58.7	4.5	85.0
N. E. R.	32,000	55	18.8	1,039	7.4	78.9	3.8	71.4
L. & Y.	29,400	54	15.3	829	7.6	83.0	4.4	68.0
H. & B.	29,600	54	15.8	858	7.4	84.8	4.6	73.8
	......	..	16.0	874	7.9	80.0	4.5	72.4

selected examples of superheated main line tender engines for both passenger and freight service.

The factor *C* has been included because of its influence on the evaporative power of the heating surfaces, a discussion on which follows later. Table III from which the average values of *B*, *BD* and *C* have been taken, shows the variations of these factors in 45 different locomotives.

Table III shows that the characteristics of the individual locomotives vary somewhat, and an examination of the proportions of the locomotives of each type and a comparison of each particular type, forms an interesting study, both as showing the ideas of each designer when building a given type of engine, and also as showing the features of each type when type is compared with type, such comparison bringing into prominence the effects of the inherent features of locomotives having different wheel arrangements. The individual values of *BD* vary considerably, but the average values given in the summary II show a striking similarity—indicating that designers in general are agreed within fairly close limits as to

For a boiler, however, which is fitted with a superheater the combustion factor should be expressed by adding the heating surface of the boiler to that of the superheater and dividing by the grate area, for it must not be forgotten that a portion of the heat generated on the fire grate goes to superheat the steam, and is not therefore available for evaporative purposes.

From a consideration of the above it would therefore seem that if locomotives using saturated and superheated steam are to be compared the factor *C* should be for saturated steam locomotives:

$$C = \frac{\text{Total Heating Surface}}{\text{Grate Area}}$$

and for superheater engines—

$$C = \frac{\text{Heating Surface plus Superheater Surface}}{\text{Grate Area}}$$

Factor of Firebox Volume

$$\text{Firebox Volume} = \frac{\text{FBS}}{\text{GA}}$$

Closely connected with the efficient combustion of fuel is the volume of the fire-box compared with the amount of coal fired. For the purpose of determining this comparison it is assumed that the grate surface will be a measure of the coal fired, and that the volume of different fire-boxes having equal grate areas will vary as the figure obtained by dividing the fire-box surface by the grate area.

Owing to the narrow and rather deep fire-boxes usual in

British practice little difficulty is experienced in obtaining a fairly considerable surface grate area ratio indicating a good fire-box volume.

In Table V,* which gives the comparative proportions of typical locomotives using saturated and superheated steam, the ratio of volume to grate area is shown in the column headed $\frac{\text{F B S}}{\text{G A}}$ and it will be noticed that both the 4-4-0 and 0-6-0 type engines have ratios of 6, and that the 4-4-2, 4-6-0 and 0-8-0 type each show somewhat lower figures. The reason for this is that in the former types the fire-boxes are usually deep, being often disposed between the driving and trailing axles, whilst in the latter types the fire-box is carried over the trailing axle and is thus shallower. Generally about 23 square feet is the limit for the grate surface if the box is between the driving and trailing axles; when larger the grate is sloped up over the rear axle, thus making it longer; the mean depth of the box is however less, and the surface grate area ratio is in consequence not so large.

Superheater Surface

$$\text{Ratio of Superheater Surface to Evaporative Surface} = \frac{\text{Sh}}{\text{St}}$$

This is expressed as a percentage of the total heating surface (St) of the boiler. From the tables of dimensions it will at once be noticed that the proportion of the total surface contained in the superheater seems to vary within somewhat wide limits, for instance, in Table 1—4-4-0 type locomotives this value ranges from 11.2 to 26.9 per cent. These differences are no doubt due largely to the different manner in which superheating surface is measured. Two superheater companies supply or control superheater equipment used, and they both seem to estimate on the steam contact surface. There are also certain other superheaters in use which have been developed on the railways using them, such as the "Horwich" superheater on the Lancashire and Yorkshire (L. & Y. R.), and the "Swindon" superheater used on the Great Western (G.W.R.) and the writer does not know how the surfaces are computed. Further—some locomotive engineers give the size of the superheating surface based on the fire contact areas, although they may use equipment specified by the superheater companies.

Factor of Efficiency of Design, E

$$E = \frac{\text{Total weight}}{\text{Total Heating Surface}}$$

and for locomotives fitted with superheaters

$$E = \frac{\text{Total weight}}{\text{Heating surface plus superheater surface}}$$

The idea of the factor E is to show the amount of weight expended per unit of power, it being assumed that the power available is proportional to the total heating surface, and at anything but the lowest speeds this is, broadly speaking, correct.

Exactly how superheated locomotives should be treated is largely a matter of opinion. As the factor E in the case of saturated steam locomotives is based on the total heating surface, it seems that superheated engines could conveniently be treated in the same manner, thus the boiler heating surface and that of the superheater would be added together and divided into the total engine weight expressed in pounds.

When saturated and superheated steam locomotives are to be compared having boilers of the same general dimensions, the value of the factor E for the superheated engine will be rather greater than for the saturated steam engine indicating a less efficient design, because the total heating surface of the boiler and superheater will be less than the total evaporative surface of the boiler without the superheater. In reality, the superheater fitted boiler will deliver the same or rather more power, so that when comparing superheater and non-superheater locomotives, the relative values of the heating surfaces must be taken into consideration. In British practice it may be taken that locomotives using saturated steam can develop a maintained output of 0.5 i.h.p. per square foot of total heating surface when running at about 240 r.p.m. and that locomotives fitted with superheaters will deliver a sustained output of about 0.65 i.h.p. per square foot of total surface in the boiler and superheater combined under similar conditions. The evaporative power and hence the power developed per square foot of heating surface can, however, be modified considerably, due to the disposition of the heating surfaces and the relative size of the grate and a discussion on this follows later.

For the various types of tank engines mentioned in Tables 2, 2A, 8, 9 and 10 the weight per square foot of heating surface has not been calculated for the reason that it would not give a factor E bearing any direct relation to the power of the engine as expressed by the extent of the heating surfaces because of the added weight due to the side tanks and bunker, and the various amounts of water and fuel carried.

The values of E for the main line tender engines taken from Tables 1, 2, 3, 4, 4A, 5, 6, 7 and 8 are summarized as follows:

Engine type	Values of E: Max.	Min.	Average
4-4-0	97.5	72.2	82.7
4-4-2	95.0	60.2	77.3
4-6-0	86.8	66.9	75.7
2-6-0	103	69.6	82.0
2-8-0	80.5	64.3	74.9
0-8-0	84.8	60.0	68.6
0-6-0	93.4	66.8	80.0
0-10-0	....	....	76.0

From a study of the tables of proportions it will be noticed that those designs which have the larger heating surfaces weigh less per square foot of heating surface that those having smaller amounts of heating surface, and that this feature holds good for all types. This fact must not be lost sight of when estimating the weight of a proposed design and using the average factors of E.

(To be continued.)

Properties of Oils for Lubricating Air Compressors*

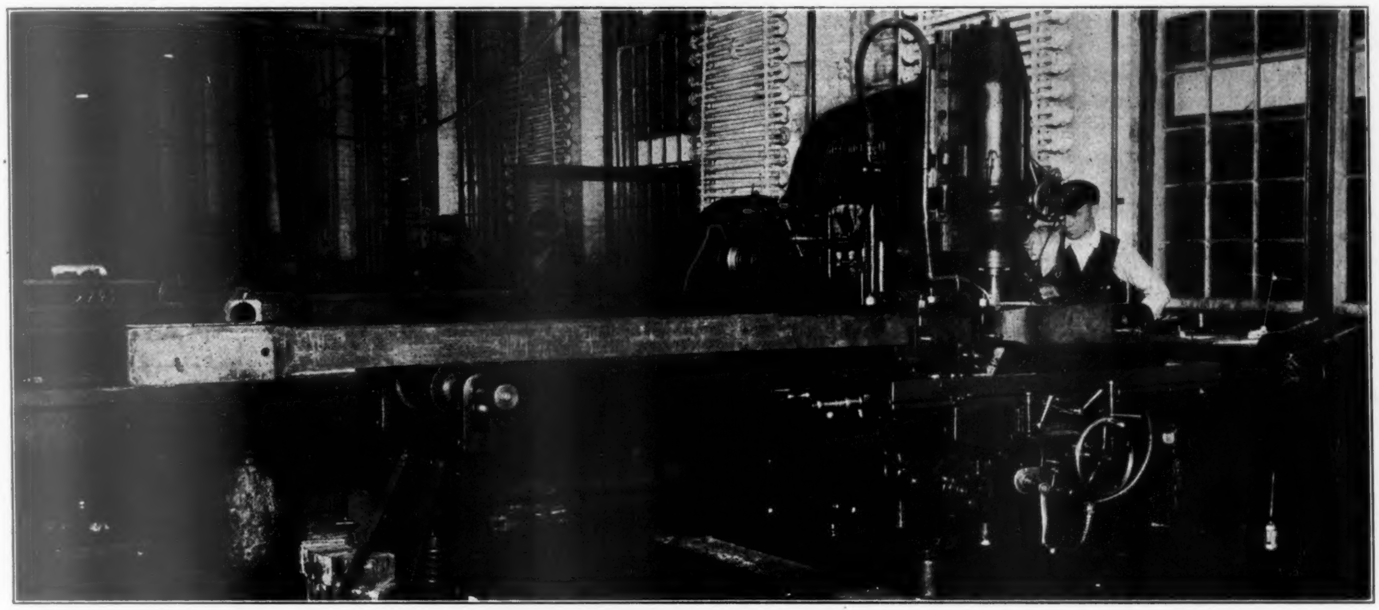
In lubricating the cylinder of an air compressor, we must use an oil that is viscous enough to resist the tendency of the piston to wipe it off and leave the metal surface dry; but the viscosity should not be great enough to offer any considerable opposition to the motion of the piston. We must remember, in other words, that lubrication is intended to diminish friction, as well as to seal the piston so that air cannot leak around it. The errors that are made in selecting oils for lubricating air-compressor cylinders probably tend toward a viscosity that is too high instead of too low. The Compressed Air Society has prepared a paper dealing with this subject quite fully. The average viscosity given therein as corresponding with good practice ranges from 230 to 315 seconds on the Saybolt scale for paraffin-base oils, and from 275 to 325 for asphaltic-base oils. The *minimum* limits for viscosity in good practice are given as 120 S. for paraffin-base oils and 175 S. for asphaltic-base oils.

The average density for good practice is given as 25° to 30° Baumé for paraffin-base oils, with a minimum of 32° and a maximum of 25°; and as 19.8° to 21° Baumé for asphaltic-base oils, with a minimum of 22° and a maximum of 19.5°. (Higher readings correspond to lighter oils.)

In connection with flash-point tests (as made by the open-cup apparatus), this same paper recommends 400° to 425° Fahr. as good average practice for paraffin-base oils, and 315° to 335° Fahr. for asphaltic-base oils—the fire test being higher than the flash point by about 50° in the paraffin-base oils, and by from 55° to 65° in the asphaltic-base oils.

*Owing to lack of space some of the tables have been omitted but will appear in the next issue.

†From an address delivered by A. D. Risteen before the Engineering Section of the National Safety Council, in Philadelphia.



Vertical Spindle Milling Machine Truing Brass Fit in Main Rod Jaws

Speeding Up Locomotive Main Rod Repairs

Rod Jaws and Brasses Should Be Accurately Machined to Eliminate as Much Hand Filing and Fitting as Possible

BY M. H. WILLIAMS

MAIN rods used on modern locomotives are so large that, when being repaired, it is laborious work to file the jaws and sides and make these surfaces true as they should be in order to properly hold the brasses. Likewise, the heavy brasses are difficult to file and handle from the vise to the rod for trial fittings. To minimize manual labor and secure greater accuracy, the work of finishing rod jaws in some railway shops is now done by machinery, resulting in the practical elimination of filing. The brasses also are machined to the proper size to fit the rods and require practically no hand fitting.

Fig. 1—Surface Grinder Used in Finishing Main Rod Sides

Doing this work by machinery may appear difficult, owing to the fact that almost no two rods coming in for repairs are exactly alike. There are slight differences in thicknesses and widths, owing to wear, previous repairs and other causes but this difficulty has been overcome in shops where the problem has received careful consideration. The methods and machinery described below are used successfully in a number of large railroad shops.

Finishing the Sides of Rods

For finishing the sides of main rods, removing irregularities and insuring that the two sides are parallel, a surface grinder can best be used. This machine should preferably be of the vertical-spindle type on account of greater ease in securing rods to the table. A rugged design having the necessary weight and strength to remove metal rapidly also is necessary. The diameter of the grinding wheel should preferably be equal to or greater than the widest part of the rods or parts to be finished in order to finish the surfaces without resetting. A good example of a grinding machine adapted for this purpose is the 22 in. by 7 ft. model shown in Fig. 1. This should be equipped with a magnetic chuck in order to admit of quickly clamping and holding the rods.

To prepare a rod for grinding the sides, the brasses are removed, after which the wedges, blocks and straps are replaced. This enables the rod and auxiliary parts all to be ground at one time, insuring that they will be of equal thickness. The rod is now placed on the surface grinder and held by the magnetic chuck with the outer end properly blocked on the machine table. One side of the rod is ground just enough to remove the depressions and rough places and make a suitable side bearing for the brasses. Generally speaking, only a small amount of material need be removed

and the rod can then be ground in a similar manner on the opposite side. After the completion of one end, the opposite end also is ground. This insures that the two sides of the rod are parallel and of uniform thickness; also the wedges and other parts will be finished flush with the sides of the rod, a desirable feature, rarely accomplished where rods are filed. After the completion of the grinding operation the wedges and blocks are removed and the rod is ready for the milling operation.

Milling Worn Rod Jaws

The operation of removing irregularities and truing up rod or strap jaws where the brasses fit can readily be performed on a vertical milling machine, a representative machine suitable for this purpose being shown in the illustration at the beginning of this article. The vertical-spindle machine is preferred on account of greater ease in clamping rods to the table and the fact that the milling operation will be in plain sight; also it is not necessary to lift or lower the rod during the milling as would be the case with a horizontal form of milling machine. As in the case of the grinder, heavy construction is necessary in order to support the weight of the rod and guard against the table binding, causing it to work hard during the milling operation.

The operation of milling a rod, as performed in one of the larger railway shops, is shown in Fig. 2. It will be noticed that the rod is held on the milling machine table by two clamps. Arrangements are made for easy leveling by means of two adjustable taper wedges on which the rod rests. The part of the rod extending past the table is held on a trestle, adjustable vertically by means of a screw and also provided with a spring to compensate for slight irregularities in the rods.

When placing a rod in the machine the following plan is

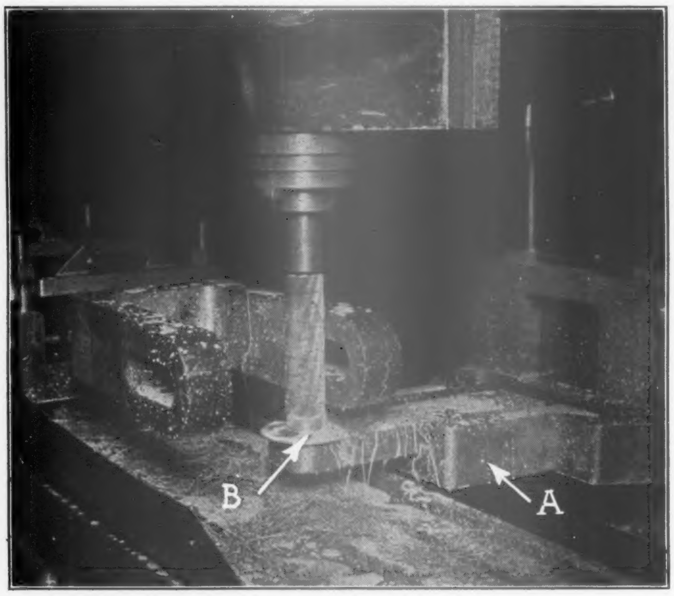


Fig. 2—Completion of Rod Milling Operation

followed. The rod is placed in the two clamps with the outer end resting on the trestle. The trestle is then adjusted to support about one-half the weight of the rod, side adjusting screws being tightened to locate the rod on the center line with the machine table. For rough adjusting, the operator sights along the rod and table, but for more accurate work, the rod is lined with a surface gage making use of the side of the table for guiding the surface gage.

In order to insure the rod being set so that the top surface of the jaws will be parallel to the machine table, a spirit level is placed on the top of the rod jaw. The wedges of both clamps are adjusted in or out as may be necessary until the rod is properly leveled. The hold-down clamps are now placed in position and tightened. If, as a result of tightening these clamps, the rod is thrown out of level, the hold-down clamps are loosened and the wedges again adjusted, after which all the holding bolts are tightened.

A milling cutter suitable for this work is shown in Fig. 2, being made about 1 in. longer than the width of the largest rod handled. The diameter is the same as the fillet in the jaws and as many cutters must be provided as there are different sized fillets. These cutters are generally cut to about a 45 deg. spiral in order to insure a smooth cut, the larger or 2-in. cutters having three teeth and the smaller two teeth. The teeth in order to cut properly have a 6 deg. front rake on


Fig. 3—Shaper and Fixture for Machining Back End Brasses

the front cutting edges. A pilot or extension is also made on each cutter to be a running fit in a bushing held in a support from the machine. The cutters must of necessity be small in diameter as compared to their length and for this reason are supported at the outer or lower end in order to prevent springing. For this support a special fixture shown at *A* Fig. 3 is used and held on the machine above the knee. The cutter pilot fits a bushing or preferably a ball bearing held in this support. In order to prevent chips entering the lower support, a deflector *B* is placed on the cutter and revolves with the cutter, throwing the chips outward by centrifugal force.

The completion of a milling operation is shown in Fig. 2. When milling, the practice is to set the cutter to the proper depth to just true up one side of the jaw. After the cutter depth is properly set, the power feed is thrown in and one side milled to the fillet. The power feed is then thrown out and the cutter fed by hand into the fillet. After this is completed the table cross-feed is thrown in and the back end of the jaw milled in a like manner. A similar practice is followed for all surfaces of the jaw that require truing up.

During the milling operation care is taken to feed the cutter in only deep enough to remove the high spots so that the rod is not enlarged any more than necessary. In fact, it is often customary to leave small spots, often called proof marks. The rod or straps after the milling operation are ready for fitting the brasses and, with the possible exception of removing burrs, no filing is required.

On account of the accuracy of the average milling ma-

chine, the sides and ends of the milled jaws are made square with each other and will be much superior to the average filing job. As the cutters used for this purpose are small in diameter they are run at a high rate of speed, generally as high as 150 r.p.m. for the 1-in. and 100 r.p.m. for the 2-in. cutters. As the cuts are light the feed can be quite rapid and may be from ½ in. to 3 in. per min., depending on the depth of cut and smoothness demanded. This rate of feed and the length to be milled will serve for the purpose of estimating the time required for the actual milling operation.

As to precautions necessary in order to obtain good work: the cutters being small in diameter must be well supported at the lower end in the bearing; also when ground they must be of one diameter from end to end, and unless this is the case errors in cutter grinding will be reflected in the squareness of the milled surfaces. The front end jaws or the straps where used on the rear ends of main rods, are milled as explained, making use of the same holding fixture.

The above method of machining these rod jaws does not present any difficulties that cannot be overcome by the average shop force. Changing from filing to milling will require time in order properly to instruct the workmen on such a new departure, but this milling operation is no more difficult than the average milling machine work.

Machining Back End Rod Brasses

The question of machining back end brasses will be considered first and in order to lead up to what may be called the most modern practices a brief reference to past methods will be made. The most common practice has been to rough

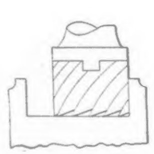


Fig. 4

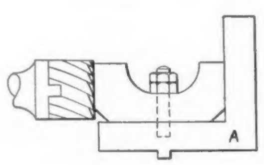


Fig. 5

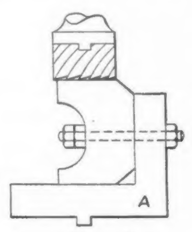


Fig. 6

out brasses on a planer where they are held in one or more rows of 8 to 15 brasses, clamped to an angle plate. Objections to this method are the relatively long time required to set up and machine the brasses and the fact that they are all standard and require subsequent individual machining, filing and fitting. A better way is to rough out and finish one set of brasses at a time on a crank planer or shaper, using an indexing fixture, as shown in Fig. 3. The angle plate of this fixture is bolted to the machine table, a pair of brasses being held on the plate by a central bolt, outside plate and set screws. Eight accurately spaced index holes are drilled in the angle plate and enable the brass to be quickly and accurately revolved to any 45 or 90 deg. position. With a well-made fixture of this design, brasses are machined in some shops so accurately that they are a satisfactory fit in the rod, and no filing is necessary except to remove burrs.

The detailed operation follows: the distance between jaws of rods is carefully measured with inside micrometer calipers; the thickness of the rod where the brasses fit is also measured with outside micrometer calipers, these sizes being recorded on blanks or memorandums. When machining, the brasses are first gone over for the roughing out operation allowing the usual amount for finishing. The surfaces that are to fit inside of the rod jaws are finished to the same dimensions as the space between the jaws; that is, one surface is smoothed up and the second side measured from the first. This dimension must be correct and is measured with great care with outside micrometers. The front and back surfaces are then planed with reasonable care, the clearance for the fillets being machined by indexing the fixture on the 45 deg. holes. About .008 in. is allowed for clearance between the brass flanges and the rod jaws.

Brasses are also milled to the correct size to fit the rod from the rough casting or when making use of brasses that have been previously roughed out on a planer as explained. The operation of milling is performed in a satisfactory manner on the vertical type machine illustrated, the castings being held in a fixture similar to that shown in Fig. 3. The general sequence of operations is similar to that used with the crank planer or shaper. Where the milling machine is used, the milling cutter is adjusted to mill the surface of one flange. The micrometer dial on the machine is then set to the zero mark, the machine table being raised to the proper height to mill the top surface and a cut taken. The table is then set over so that the return cut will mill a space that will be the required distance between flanges. For this operation it is necessary to carefully measure the distance between flanges in order that they shall be of the width required. When the proper distance has once been made correct, the position of the micrometer dial is noted and recorded for use when milling the remaining flanges. The fixture is then indexed to the next quarter and the end surface finished. When milling this surface, and in fact, all the remaining surfaces, the first cut is taken with the micrometer dial set on the zero and the return cut with the dial set to the same place as the previous milling. The third side is now milled, when it is necessary to measure the distances between the two surfaces which fit between the rod jaws. This is done, as has been explained in connection with the planing operation. The remaining end and the clearances for fillets are now milled in a similar manner. For this milling operation the cutters must have a diameter about two-thirds the distance between flanges and of length about equal to the greatest depth of flange as illustrated in Fig. 4.

Milling has several advantages as compared with planing: the surfaces will be much smoother than where planed and by using the micrometer dials on the machine, the distances are set so that one setting does for all of the flanges of a single set of brasses; also the time for doing the work is less than planing. This milling work is also done on horizontal knee type machines in which event the brass is held in a circular milling attachment similar to that shown in Fig. 3, only set on its side. In some cases the regular circular milling attachment such as supplied by milling machine makers is used. The main advantage of the vertical spindle machine is due to the operator having a better view of the progress of the work.

The advisability of milling brasses from the rough castings will be governed largely by the grade of brass or bronze used. With a free cutting metal they may be milled economically. However, with some grades of bronze, the wear of cutters is so great that the cost of their upkeep outweighs any possible saving as compared with planing or shaping. Where the brasses are first roughed out and the outside scale removed, the life of the cutters between grindings will be much greater and, in this case, the operation of milling to fit rods may be done economically.

Machining Front End Brasses

Machining front end brasses to fit the rods is a comparatively simple operation. In most cases their horizontal length is not of enough importance to require separate machining for each individual pair and for that reason they are roughed out in quantities, allowing extra metal only on the top and bottom surfaces to admit of finishing to fit the varying sizes of rods. This work is often done on a planer.

When finishing to fit the rod, a horizontal type milling machine, shaper, or crank planer may be employed, the brasses being held in fixtures as shown in Fig. 5 and 6. These two fixtures are quite similar, being made up of an angle plate with a tongue fitting the machine table. The

length of the angle plate is less than the width of the shortest brass handled, in order that one end may extend past the fixture for the purpose of calipering. The rod brass is held in place by two bolts and a clamp as shown.

The operation of measuring and machining these parts is as follows: The rod jaws are carefully measured with inside micrometer calipers and the size recorded. The brasses are placed in the fixture one-half at a time and firmly clamped, The surface to be fitted is then carefully machined to the required size which will be practically the size of the rod jaws. This size of the brasses is measured with outside micrometers. The second half is machined in a similar manner. This is not a difficult machining operation and where reasonable care is exercised, the brasses will be a neat drive fit in the rods.

Comparison of Machine and Hand Fitting

It would be well at this point to consider the pros and cons of this method of machine fitting as compared with roughing out, filing and fitting by the cut and dry methods. It goes without saying that the brasses both front and rear should be a light drive fit, and also have true surfaces in order to present a good bearing in the rod and not work loose. In order to obtain the close fitting demanded, any method will require close measurements and machining. If this be done by filing, the rod and brasses each must be calipered several times, or several trial fittings must be made of the brasses, all of which takes time. Also filing a rod brass perfectly square and flat so that it will compare with planing or milling is a job that can be done only by an expert.

Where the rods are repaired on the milling machines and grinder as explained, the surfaces fitting the rod brasses will be true and square. This reduces the work of fitting the brasses very materially. In order to insure a brass fitting at first trial it is necessary to measure the rod and brass very carefully, which for a person not experienced in this line of work will consume time. However, where this practice is followed, the men become expert in measuring so that but a small amount of time is required. By this method the micrometer measurements serve the same purpose as several trials of the brass in the rod where the older plan is followed. Micrometers are much easier and quicker to handle than a rod brass and as a result the laborious work is greatly reduced.

Fuel Accounting*

It is the recommendation of the committee that fuel accounting be handled by the auditing department. This does not affect separate organizations or departments which handle the purchase, inspection, nor use of fuel. Every railroad engaged in interstate commerce is guided in its final accounts by certain rules and regulations laid down by the Interstate Commerce Commission. The accounting department of every railroad understands these regulations and knows how to meet the requirements with regard to the allocation of fuel charges to operating expenses. Therefore, all forms used in connection with fuel accounting, are designed to meet these ends.

After the general purchasing agent has arranged contracts for delivery of coal, a mine manifest should be rendered daily to cover all coal shipped, showing destination, waybill reference, kind of coal, car number and initial, and gross, tare and net weights, one copy going to the fuel supervisor and one to car service department or the party handling the distribution of coal The coal contractor should forward to general purchasing agent an invoice for all coal shipped, who will approve as to price, etc., and pass to the accounting department.

*From the report of the committee on Fuel Accounting presented at the 1921 convention of the International Railway Fuel Association.

After arriving at distributing or junction point, a diversion report is compiled for the party handling distribution, showing car number and initial, original waybill reference, point to which diverted, shipper, and to whom and why diverted.

After the coal has arrived at the unloading station, the coal dock foreman must inform the fuelkeeper of the amount of coal received and unloaded so that he can render a daily report to the accounting department, with copy to the fuel supervisor; the accounting department to check receipt against invoice before passing for payment. The coal tickets covering issues to locomotives are handled by the coal dock foreman and passed to the fuelkeeper each day. The form for reporting coal received and unloaded provides for showing the waybill reference, the weight of the coal, and the amount unloaded is carried forward from day to day so that the report at the end of the month will show the total amount of coal delivered to locomotives, or otherwise charged out at the station where unloaded. There should be a place provided on the reverse side of the daily unloading report for showing all cars on hand not unloaded. From this and the diversion reports information to locate every car is available.

As coal is generally put through chutes with no weighing device and as estimates of issues to individual locomotives necessarily follow, some adjustments will be required to balance with the inventory. A ten day or shorter period trial balance is therefore the solution in order to correct discrepancies before they become thirty days old, rendering the adjustments so heavy that the accuracy of charges to the individual locomotives and classes of service might be questioned.

Coal spilled at chutes should be picked up every day, if possible, and put back into the chute. If it is not possible to do this with some type of chutes, it should be done at least as often as trial or regular balance is taken, so that the report at the end of the month would show a balance requiring minimum adjustments.

A careful record should be kept of coal issued, and to do this it is necessary to keep before the fuelkeeper a working sheet on which the days of the month are shown, with headings covering every known use of fuel, on which fuelkeeper should be required to show distribution every day, so that at the end of the month the various items may be added and made ready for the balance sheet.

The balance sheet should provide a place for showing inventory and coal received and disbursed for all purposes. This report, with the tickets supporting the issues to locomotives, should be forwarded to the auditing department promptly after the close of each month, but only after the fuelkeeper has checked the agent's record to see that he has accounted for every car of coal reported by the agent to the auditor of freight accounts as being unloaded at his station.

To avoid omitting in the report of fuel received the cars under load at the closing period, it is essential that a record be maintained of cars received but not unloaded.

For distribution of fuel to locomotives, a separate form should be used which will show allocation of fuel to each individual locomotive, subdivided as between various classes of service in which the locomotive may make mileage. The form should accompany the balance sheet and will permit the auditing department to make proper charge of fuel to every locomotive.

Fuel oil, which is in general use on many of the western and southwestern roads, should be accounted for under the same basic principles as outlined above.

The report is signed by J. N. Clark (Sou. Pac.), Chairman; R. R. Hibben (M. K. & T.); R. E. Jones (D. & I. R.); C. F. Ludington (Crescent Coal Co.); Joseph McCabe (N. Y., N. H. & H.); Hugh McVeagh (Big Four); C. F. Needham (Grand Trunk); H. E. Ray (A., T. & S. F.), and W. J. Tapp (D. & R. G. W.).

Insulation of Passenger and Refrigerator Cars

A Discussion of the Principles Involved in Determining Heat Transmission Under Various Conditions

BY ARTHUR J. WOOD

WITH the introduction of steel postal cars, the railroads found themselves face to face with the seemingly simple problem of determining whether an insulated car section met certain specified requirements for the amount of heat flowing through a wall section. In order to determine the heat transmitted through a duplicate section or blank similar to one cut from the wall of a car, the Post Office Department specified that the blanks be tested in a new box calorimeter, commonly known as the Postal Text Box. This calorimeter is not a scientifically constructed apparatus, but it has been used in a number of laboratories for determining approximately certain constants.

The specifications stated that the minimum requirement for acceptance of the insulation should be based on a certain amount of heat flow between the inside and outside walls of the section. Since no method was provided for determining the temperatures of the wall surfaces, it has been interpreted to mean that total transmission (which includes the two surface transmissions), and not conduction of the compound wall, was the intent of the specification. The writer has pointed out as a result of extended tests* that the Postal Box when used as directed, is unreliable for even approximate results and the Railway Age Gazette** suggested editorially, that the specifications should be revised.

There are four outstanding sources of error in this box: (1) use of mercury thermometers, (2) radiation from the exposed heating wires, (3) placing the blanks too close (3 in.) together, (4) uncertainty in determining the area through which the heat flows. This last mentioned source of error is in itself sufficient to condemn its use for car sections with an air space, even if the blanks are placed flush and temperature measurements are made properly.

A more accurate determination may be made by calculating the heat transmission (if the conductivity of each material used is known) than can be found by inserting blanks of a car section in the Postal Test Box.

The study of heat transmission is by no means simple, and one should approach the subject with full appreciation of the factors involved. The laws of conduction, convection and radiation, the various influences affecting surface transmission, the significance of air space construction, together with a knowledge of right method of testing, should form the basis of a study of the subject. Sometimes, approximate methods will answer the immediate need of the engineer, but this is hardly true of the subject of heat transmission. It is of first importance to know the extent of probable errors involved in any methods employed, and this is occupying much of our attention at the Thermal Plant of the Pennsylvania State College. It is apparently an easy matter to make tests in heat transmission and determine new constants for insulating and building materials. This has been done to such an extent that engineers have been confused rather than helped, because the methods employed were not fully stated or were not based on a scientific study of the problem.

Mr. Allman's Paper

The article by Wm. N. Allman in your issue of July, 1921, contains many points which may well be studied by those who desire to apply the theory to practical problems; however, his treatment of the subject is not altogether satisfying.

1. Table III, Page 447, Thermal Conduction in Air Spaces, may be confusing in two particulars,

(a) The values under C and K should be transposed. C should equal the B.t.u. for the thickness given in the first column and K the B.t.u. for one inch thickness. This typographical error has been handed down from the original paper by Dickinson and Van Dusen as printed in the Journal of American Society of Refrigerating Engineers, September, 1916.

(b) For all practical purposes the value of K may be omitted from the table, for it may readily be misinterpreted. For two temperature differences, Table III as given by Mr. Allman would read as follows:

TABLE I—THERMAL CONDUCTION B.T.U. PER 24-HR. OF VERTICAL AIR SPACES 8 IN. HIGH.

Width of spaces, in.	Temp. diff. 18 deg. F. C	Temp. diff. 45 deg. F. C
1/8	50	53
1/4	32	34
3/8	26	28
1/2	23	25
5/8	22	25
3/4	22	26
7/8	22	26
1	22	26
	Air Spaces 24 in. High	
1/2	22.0	24
1	19.1	23
2	18.4	23
3	18.7	22

Corrections for radiation in the above values may be made by applying the law of Stefan and Bolzmann with the proper constants. Also, to use the table accurately, one must know from test or from calculation the probable temperature drop through the air space. A value of 1, the conduction per hour, for spaces 1/2 in. and over in width, is a safe approximate value.

2. Does an air space in the wall of a steel postal or refrigerator car remain a dead air space for a considerable length of time? Probably not, and yet some break in the insulation as usually inserted, would not entirely offset the good effects of the insulation unless there was a current of air through the space. In general, it is better to insert insulation in such spaces. Before one can answer many of the questions about the effectiveness of air space insulation in refrigerator cars, we should have accurate information about the conditions before and after cars have been in service.

If the 3 1/2 in. air space, Fig. 2, was divided up by building paper into three air spaces, each approximately 1 1/8 in. in width, there would be added four additional surface resistances and two additional air spaces and the conduction of the total air spaces would be about 1/4 that given for the one space. A calculation is later made to show the effect of such arrangement on the total transmission.

Tests on air spaces of different construction show the following results:*

TABLE II—CONDUCTION PER DEGREE F. THROUGH AIR SPACES, AT 18 DEG. F. TEMPERATURE DIFFERENCE.

	C Conduction; outer surface to outer surface.
Three 1/2" air spaces	0.286
Three 1" air spaces	0.219
Three 1 1/2" air spaces	0.183

In our air space tests, three cubical boxes were constructed

*A.S.R.E. Journal, Jan., 1918: Bulletin No. 30, Eng. Exp. Station, The Pennsylvania State College.
**Railway Age Gazette, December 22, 1916.

*Derived from values given in Bulletin No. 30, "Heat Transmission; Corkboard and Air Spaces," by A. J. Wood and E. F. Grundhofer.

about a cubical heating element, the boxes being built up in thickness of 1½ in., 1 in. and ½ in. respectively. The results show that by taking three 1½ in. air spaces to represent an insulating value of 100 per cent, three 1 in. air spaces represent an insulating value of 84 per cent, and three ½ in. air spaces represent an insulating value of 64 per cent, these values being based on conduction.

Tests on ½ in. air spaces 7½ in. high, gave the following values: If three air spaces ½ in. each in thickness represent an insulating value of 100 per cent, then two ½ in. each represent an insulating value of 79 per cent and one air space ½ in. thick represents an insulating value of 59 per cent, based on total temperature difference, outside to outside.

3. *Surface Transmission.* Mr. Allman states that it is safe to assume a surface conductivity in still air of 2 B.t.u. per square foot, but he avoids using any value for the outside surface and does not explain why this term is omitted. The above value is on the safe side for one surface, but is higher than we have found recently at our Thermal Plant of the Pennsylvania State College for the ordinary insulating and building materials subjected to natural convection. The value of K varies from .9 to 2.0 for one side of a surface and for materials of different character. The average value from twenty tests on corkboard for ranges of different temperature differences from 30 to 70 deg. F., gives 1.1 B.t.u. per hour for the constant. For a smooth surface exposed to some air movement the writer uses 1.5. It is not important to know very accurately the value for surface transmission in the case of good insulation, but it becomes more and more the determining factor as the combined conduction of the materials used in a structure becomes greater.

But what is its value for the outside surface of a car, subjected to high velocities? There is one assumption on the safe side, at least until more data is at hand, and that is to take the temperature of the surface equal to that of the air; in other words, to assume that the heat is brushed off the surface as rapidly as it passes to the surface. This will give a value of outside surface transmission equal to zero. I determined the values from which the curves in Fig. 1 in Mr. Allman's paper was plotted, on a five-foot square insulated postal car section with air passing over the surface parallel to the blank, and this gave a multiplier of 2.3 for an air velocity of 20 m.p.h.; that is, the amount of heat transmitted was 2.3 times that obtained under still air conditions. When it is necessary to use a multiplier for high velocities, I would recommend the value of 3.

Exactly how is the heat conducted away from a surface? This is an interesting question to many and offers the basis for further analysis. In Fig. 1, is reproduced a curve from the center of a 2 ft. square blank of corkboard 1 in. thick, in still air. It will be observed that readings were taken by about 1/16 in. intervals close to the surface and then further apart as the distance from the surface becomes greater. The drop in temperature is rapid during the first inch, and at two inches from the surface the room temperature has nearly been reached. Half of the total drop occurs within ¼ in. from the surface.

One of the purposes of obtaining the surface gradients is to study the effect of convection currents, for these changes in temperature are due to the natural movement of air caused by the absorption of heat along the face of the plate, corresponding to the conditions of the outside wall of a car in still air. In most cases of thicker insulation, as here shown, the average outside temperature will not be reached for two feet or more. It is therefore important to note carefully where the outside temperature is observed.

To obtain the outside coefficient (K_2) of surface transmission in Fig. 1,

$H = K_2 (T_1 - T_2)$, where

H is the heat flow per sq. ft.,

T_1 is the temperature of the surface and

T_2 the temperature of the air passing to the lower surface of the plate,

$10.185 = K_2 (45.5 - 34.6)$.

$K_2 = .93$ B.t.u. per deg. F. difference.

The heat resisting or insulating value of this surface would be equivalent to that of ⅓ in. corkboard, which is

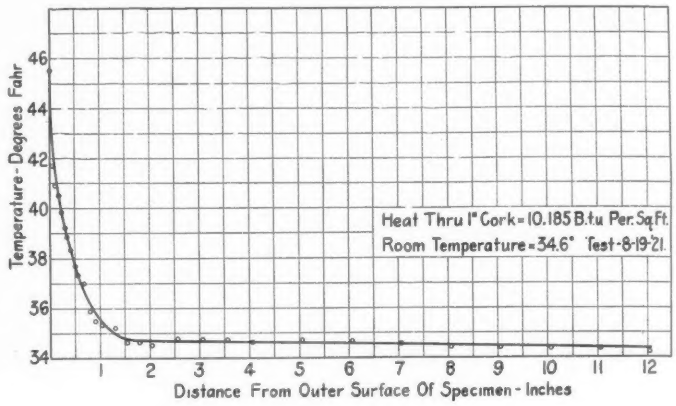


Fig. 1—Surface Gradient of a Corkboard Blank—Natural Convection

In this test one-half the total temperature drop occurred within ¼ in. from the surface. This brings out the importance of the air near the surface influencing heat transmission.

the value for the conditions of this test and is approximately true for the average condition of good insulation.

Not much of value has been added to our knowledge of surface transmission since the classic researches of Peclet published in 1829, and the later work of Grashof and Rietschel. The accurate determination of surface effects calls for refined methods of measuring heat flow and temperatures. At the Thermal Plant of the Pennsylvania State College, we are extending our previous work with greater accuracy. The new test plate which is 3 ft. square, including the guard ring, may be used in a constant temperature room for determining,

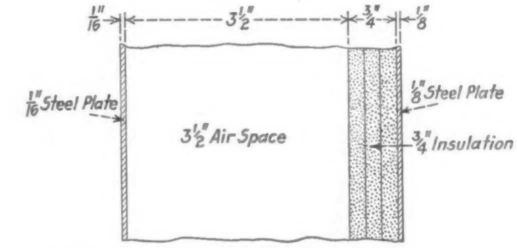


Fig. 2—Representative Section of Steel Passenger Car Wall

at the same time, both surface transmission and conduction. One distinct advantage of this plate over the box method of testing is apparent in the case of testing high temperature insulation, as boiler lagging in locomotives; the temperature and heating conditions can be made similar to those on the boiler.

4. *Constants.* Mr. Allman gives in his Table IV, values for many materials from tests by the Union Pacific in 1914. Unfortunately he does not state how these constants for heat transmission were determined. Are the values for conductivity or for total heat transmission (which includes the surface effects)? He uses them in his equation as if they were conductivity but they are total transmission values if obtained by the Postal Box as designed and used according to the instructions, or by any method where surface temperatures were not observed. While the results of some of the materials check fairly well with later accepted values, these tests do not bear the marks of results from a scientific investigation. The values should not be accepted, at least not

until the methods by which they were obtained are fully stated. In the table "weight per sq. ft." evidently refers to the weight in ounces for the thickness given and the B.t.u. per sq. ft. per deg. F. difference in temperature per 24 hrs., is evidently per inch thickness, and not for the thickness of the test blank. This is inferred from values such as for "Headlining" where it gives a value for 1/4 in. thickness as 15.816 B.t.u. per 24 hr., and the next line gives 14.328 B.t.u. for 31/32 in. thickness. Mr. Allman uses the value for 3-ply salamander as if the table gave the value for conductivity for 3/4 in. instead of per inch.

The table for thermal conductivity as determined by the Bureau of Standards by the plate method, and which is given in his Table II, page 445, is unquestionably the most trustworthy recent table of constants for conduction for materials used in car and other temperature insulation.

5. *Calculations.* Fig. 2 is the same as used by Mr. Allman and is reproduced to examine into different methods of calculation. Mr. Allman calculates the total transmission H per hour for 1 deg. F. difference, between the inside and outside temperatures, from the general equation for a compound wall;

$$H = \frac{1}{\frac{1}{K_1} + \frac{d}{c} + \frac{d_1}{c_1} + \frac{d_2}{c_2} + \text{etc.} + \frac{1}{K_2}}, \text{ where}$$

K_1 = Inner surface conduction.
K_2 = Outer surface conduction.
d, d_1, d_2, etc. = Thickness of each element in wall.
c, c_1, c_2, etc. = Thermal conductivity (per hour) of elements corresponding to thickness d, d_1, d_2, etc. per inch thickness per sq. ft. per deg. F.

Mr. Allman uses but one value for surface resistance which he calls $\frac{1}{K}$, but does not state if this is for one or for two surfaces. When the formula is to apply to total temperature difference between inside (T_1) and outside (T_2) temperatures, the above formula should be multiplied by ($T_1 - T_2$).

For Fig. 2:

$$H = \frac{1}{\underset{\text{surface}}{\tfrac{1}{2}} + \underset{\text{steel}}{\frac{.125}{322}} + \underset{\text{salamander}}{\frac{.75}{.2055}} + \underset{\text{air}}{1} + \underset{\text{steel}}{\frac{.0625}{322}}}$$

= .194 B.t.u. per hr. per sq. ft. per in. thickness per deg. F difference in temperature,

or 4.656 B.t.u. per 24 hrs. . . . .(1)

which he states is well within the figure 8 B.t.u. as stipulated by the Post Office Department. For all practical purposes the effect of conductivity of the steel plates may be omitted, as they would change the final values only about 1/4 of one per cent, so that the second and fifth terms in the denominator will disappear. The value for salamander from the Union Pacific table would be .274 B.t.u. per *inch* if the table gives conductivity (and if it is correctly determined), but as pointed out, this table evidently gives total transmission and the probable value of its conductivity figures to be .466. We will first omit the value for the air space on the assumption that it is not a dead air space, giving for the heat transmission, H, for Fig. 2;

$$H = \frac{1}{\underset{\text{inner surface}}{\frac{1}{1.5}} + \underset{\text{salamander}}{\frac{.75}{.466}}} = \frac{1}{1.297} = .435 \text{ B.t.u. per hr.}$$

or 10.4 B.t.u. per 24 hrs. . . . .(2)

which is not within the limits specified.

If the air space is included and its value taken as 1

$$H = \frac{1}{\frac{1}{1.5} + \frac{.75}{.466} + 1} = .305 \text{ B.t.u. per hr.}$$

or 7.32 B.t.u. per 24 hrs. . . . .(3)

which safely falls within the limits.

If the air space was filled with mineral wool, or an equally good insulation, the probable total transmission would be:

$$H = \frac{1}{\frac{1}{1.5} + \frac{.75}{.466} + \frac{3.5}{.288}} = .068 \text{ B.t.u. per hr.}$$

or 1.63 B.t.u. per 24 hrs. . . . .(4)

If the air spaces had been divided up by building paper into three air spaces of approximately 1 in. thick each (see Table II), the total transmission would be:

$$H = \frac{1}{\frac{1}{1.5} + \frac{.75}{.466} + \frac{1}{.219}} = .147 \text{ B.t.u. per hr.}$$

or 3.528 B.t.u. per 24 hrs. . . . .(5)

If the specifications are interpreted literally and the amount of heat transmitted is measured between the inside and outside walls, the term $\frac{1}{1.5}$ would be omitted from Equation 3, giving 9.19 B.t.u. per 24 hrs. The writer believes this to be the rational method of specifying the requirements in a car section.

The same methods as applied to Fig. 2 may be applied to a refrigerator car section and anyone may figure for himself the probable heat transmission through a compound wall.

The above calculations do not go into questions of heat transmitted through braces, struts and rigid members of a structure which require a separate analysis, aside from the purpose of this paper.

The several methods of applying the general formula are presented to indicate (1) the necessity for knowing the condition of the structure and (2) the function of a dead air space compared with the same space filled with a good insulator.

Further Investigations. More extended scientific investigations are needed on the following projects in order to assist in the better design of insulated walls. The railroads are directly concerned with research work along these lines:

1. Surface transmission in still air.
2. Surface transmission in moving air.
3. Surface transmission as affected by humidity and by rain.
4. Conduction as affected by moisture.
5. Effect of radiation as a correction factor.
6. Heat transmission of walls in place.
7. Influence of struts in a compound wall.

WOMEN EMPLOYEES IN RAILROAD SERVICE.—The classification of women employees of Class I roads for the year 1920, shows that female employees are engaged in many different classes of service. In the shops, there are small numbers listed as blacksmiths' helpers, boiler makers' helpers, machinists' helpers and molders' and coremakers' helpers. In roundhouse work, approximately 200 are employed wiping engines, with smaller numbers employed cleaning headlights and lanterns, supplying engines and operating turntables. More women are employed in car work than in any other branch of the mechanical department, the majority being listed as clerks and laborers. In addition, there are about 100 upholsterers and seamtresses, 50 pattern makers' helpers and about 90 painters' helpers, the remainder being listed as pattern makers' helpers, coach and car carpenters' and repairers' helpers and car inspectors' helpers.

A Welded Locomotive Tender Tank

BY J. W. MURPHY

General Foreman, Boston & Albany, West Springfield, Mass.

About six months ago, the Boston & Albany built at its West Springfield shops a tender tank of 8,000 gals. capacity, which was constructed entirely by welding the parts together by the electric arc process. So far as is known, this is the first departure from the customary riveted type construction for tender tanks.

Considerable experience had been gained with electric welding, particularly in boiler work, and in view of the successful results obtained and the adaptability of this process for welding seams of tanks, it was decided to construct a complete tank by electric arc welding. In the case of a riveted joint, considerable time is required for laying out and punching rivet holes and caulking. This work is not necessary in the case of electrically welded joints. Riveted joints cannot equal in strength the solid plate on account of the loss of metal at rivet holes, but welded joints if properly made have the strength of solid plate. It is recognized that the welded joint is strong and reliable and in the case of tank work there is the added advantage of freedom from leakage.

The electric welding process is superior to the oxy-acetylene process for certain kinds of work and is peculiarly adaptable for joining plates and welding seams. Oxy-acetylene welding can be used successfully in many kinds of repair work, but it is difficult to weld steel plates or sheets by this process on account of buckling and bulging produced by the heat.

The manner in which the sheets were welded to the tank angles is shown by Fig. 1. This is a satisfactory method as the welding can be done readily at reasonable cost and the strength of the joint is in excess of that usually obtained by the riveted type of construction. The side plates are butt-welded and the tank braces and splash plates are afterwards securely welded to the side sheets. The whole construction results in a water-tight tank of good appearance and great strength.

In assembling the various parts of the tank, approximately 1,200 linear feet of welding was done. The following tabulation shows the welding work in detail:

Butt-welded seams ¼ in. plate	95 ft.
8 Reinforcing tees, 3½ in. by 3½ in. by ⅜ in.	550 ft.
10 Tank angles, 2½ in. by 2½ in. by 5/16 in.	410 ft.
23 Side tees, 3½ in. by 3½ in. by ⅜ in.	120 ft.
Beading at coal side	25 ft.
Total linear feet of welding	1,200 ft.

The safety appliances and tank lugs are riveted to the sheet. The completed tank is 26 ft. long, 10 ft. wide and 5 ft. 2 in. high, having a capacity of 8,000 gals. of water and 12 tons of coal. It is supported on a cast steel underframe and is used with a Pacific type locomotive in passenger service. The photograph shows the appearance of the completed tank, the absence of rivet heads being particularly noticeable.

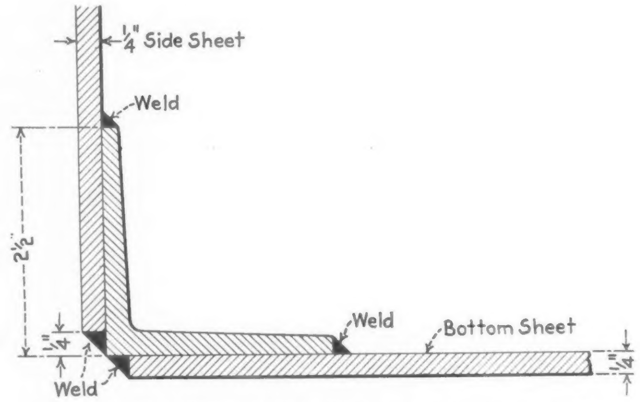


Fig. 1—Detail of Joint Between Angle and Sheets

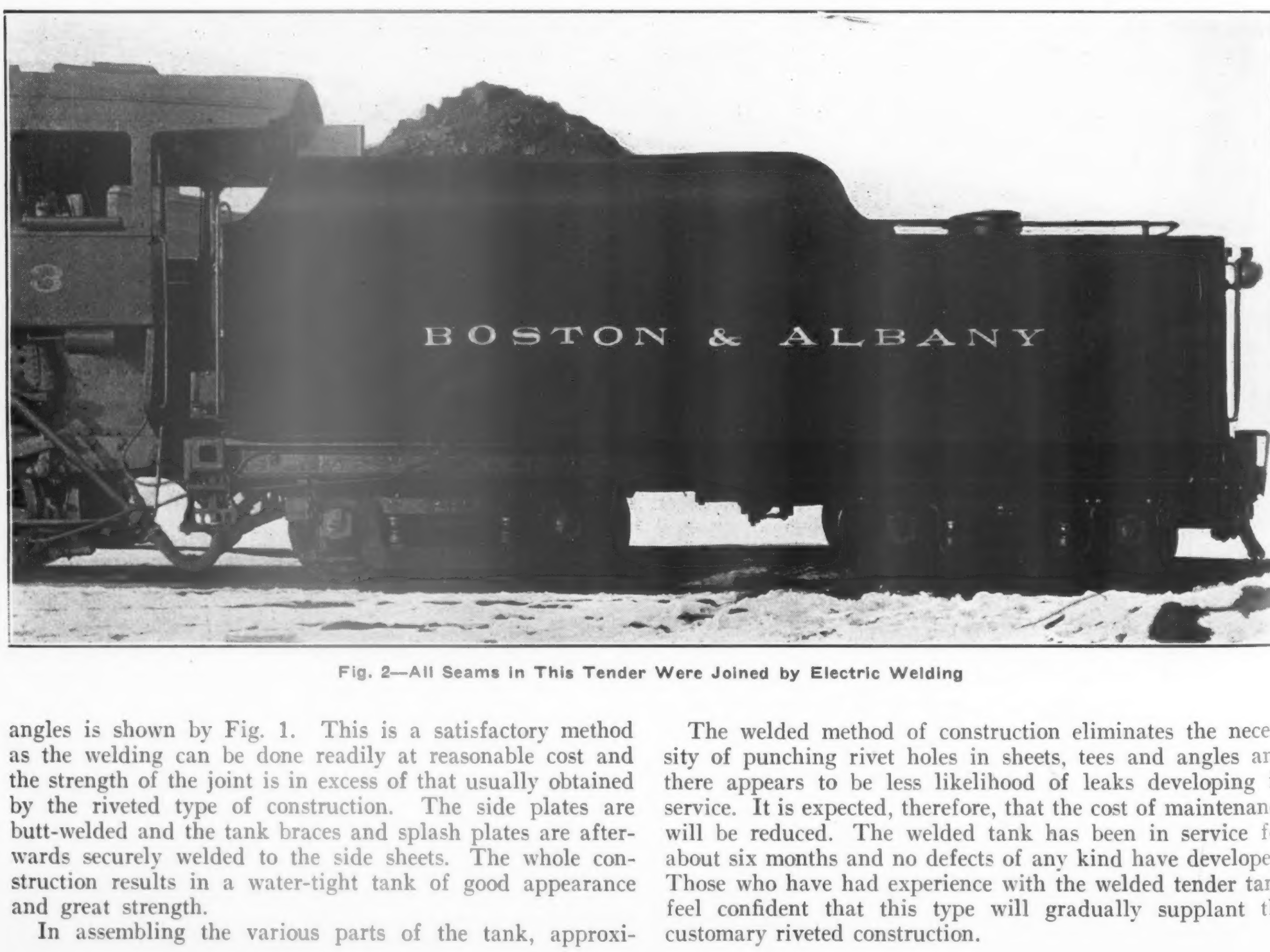


Fig. 2—All Seams in This Tender Were Joined by Electric Welding

The welded method of construction eliminates the necessity of punching rivet holes in sheets, tees and angles and there appears to be less likelihood of leaks developing in service. It is expected, therefore, that the cost of maintenance will be reduced. The welded tank has been in service for about six months and no defects of any kind have developed. Those who have had experience with the welded tender tank feel confident that this type will gradually supplant the customary riveted construction.

Cost of Operating Obsolete Machine Tools

Problems Arising in Its Determination; The Cost of Manufacturing Finished Railway Material

BY R. S. MENNIE

IN any comparison between the machine tool equipment of an average railroad shop and that of a modern manufacturing plant, it will be quite evident that the latter is almost invariably provided with superior facilities. It will be found that antiquated machines are constantly used in railroad shops, which would not be tolerated in a successful manufacturing establishment.

To account for this fact we should remember that railroad shops are not engaged in the production of articles which must be sold at a profit. It is true that the railroad as a whole must operate at a profit or face ultimate disaster, but unfortunately this necessity has not the same direct bearing upon shop conditions that obtains in the industrial field.

Manufacturing companies usually have separate selling and shop organizations. Shop operations have a fundamental importance, exerting an immediate and vital effect upon the entire business. If these operations are conducted with waste or inefficiency, it is only under exceptional circumstances that the selling end of the organization can offset this loss by obtaining higher prices. Consequently, all factory matters having any effect upon the cost of manufacture are closely observed and by means of accurate accounting systems the management is able to locate inefficient conditions and apply corrective measures without expensive delay. We can therefore readily understand why obsolete machinery is quickly dispensed with under the urge of modern competitive production methods.

Cost Information Necessary

In a railroad shop, however, due to the absence of any real cost accounting system, it is impossible to show from day to day the exact cost of each unit of work done on these antiquated tools. If railroad shop officers had at their disposal accurate accounting methods similar to those used in the industrial field it would be a simple matter to compare the cost of certain items of work performed on obsolete machines and the same operations handled with modern facilities. Having unquestionable and reliable information very little further argument would be necessary to convince the management as to the advisability of installing new equipment.

It is of slight value, however, to enlarge upon what might be accomplished under certain ideal conditions unless one is prepared to show how these conditions can be brought about. It will no doubt require a considerable period to introduce and develop cost accounting systems for railroad shops to a state of practical perfection. In the meantime it may be of interest to discuss present possibilities and the problem before many shop officers of presenting facts to the management in a logical and convincing manner regarding the economic necessity for new machinery.

Requests for Machinery Without Facts Are Unsatisfactory

The usual procedure on the part of local shop officers is to obtain new machine tools by what might be called the "agitation method." Through persistent correspondence, conversation and other propaganda it is quite possible eventually to bring the management to the required state of mind, whereupon authority is granted for the necessary new facilities. The length of time that transpires in accomplishing this much desired result depends largely upon financial conditions and whether or not the higher officers have become somewhat immune and do not readily react to requests for purchases upon the basis of estimated savings which in the past have not always materialized. In fact, there is at times a decided inertia in regard to these expenditures.

However, as the cumulative effect of persistent small efforts is sufficient to overcome a comparatively great inertia, mechanical department men have gradually been able to replace some old machinery. The process is slow, at times discouraging, and the money lost by inefficient shop operations during the period of agitation is frequently sufficient to pay for the new tools with a considerable surplus in addition.

Matters of this kind are often a great puzzle to shop men and others not perhaps familiar with all phases of the situation. Consider the case of a machinist whose work consists in the daily operation of an old lathe that should have been scrapped 10 or 15 years ago. When he makes the necessary adjustments for a cut, perhaps one-half of what might be taken on a modern machine, and sets the feed to correspond, he knows beyond question that here is a waste involving many dollars. Consequently, his attitude toward any campaign for economy inaugurated by the management is at times tainted with a touch of sarcasm.

Nevertheless, while a mechanic or shop officer may be absolutely confident in his own mind that big savings could be made by installing new machinery, he is frequently at a loss when the time comes to demonstrate just what the anticipated savings would amount to in dollars and the exact manner in which his conclusions are arrived at. What the business man in charge of a railroad company's finances must have is a clear statement of facts, showing beyond question that the proposed investment will be profitable.

Preparation of Comparative Cost Statements

The preparation of such statements in the absence of a suitable cost accounting system can perhaps best be accomplished by making a careful analysis of operations performed on each machine. The number of units produced under normal working conditions should be ascertained, together with the cost of labor, power, belting and every possible item of expense. The initial investment should also be obtained and all capital charges included in the itemized statement of operating cost. The following examples will serve as a guide and may possibly be of some assistance to those not familiar with matters of this kind.

The first is a simple statement showing the annual operating cost of an obsolete 37-in. vertical boring mill, installed about 30 years ago at a total cost of $3,800, including foundation, countershaft, belting and all incidentals. The average production obtainable from this machine in the hands of a competent mechanic is three units a day, or 900 a year, with a power consumption of approximately 20,000 horsepower-hours.

With the above information at hand a statement may then be prepared somewhat as follows:

Estimated Operating Cost of Old 37-in. Boring Mill

Interest on investment: $3,800 at 6 per cent	$228.00
Depreciation: $3,800 at 5 per cent	190.00
Maintenance: $3,800 at 4 per cent	152.00
Insurance and taxes: $3,800 at 3 per cent	114.00
Labor: 85c. per hour, 2,400 hours a year	2,040.00
Power: 19,200 horsepower-hours at 2c.	384.00
Oil, waste and grease	40.00
Total annual operating cost	$3,148.00

As this machine produces a total of 900 units a year the cost per unit will be $3,148.00 ÷ 900 = $3.50. In making

these estimates it has been the writer's practice to determine the productive possibilities of a machine by ascertaining the number of units produced under average conditions in a given period. A unit may be a cylinder head, a piston head or any similar locomotive part. After running a short test to determine the rate of production, this rate may be used to arrive at the annual average output. Actually, however, in the course of a year the machine will be used on many different kinds of work, but for the purpose in view, this variety of output can be disregarded and the computation based upon a single unit of production.

In comparison with the old 37-in. equipment we shall now consider a 1921 model, 42-in. vertical boring mill. This machine, due to its massive construction, careful design and numerous time-saving features, will produce at least three times as much work as can possibly be accomplished on the older mill. The cost of this tool is about double that of the 37-in. machine and the power consumed is also considerably greater. Nevertheless, it will be found if a careful study of operating cost is made that the replacement of an antiquated 37-in. boring mill with a modern 42-in. machine will return an excellent percentage on the investment, providing of course that sufficient work is available to keep the new machine fully occupied.

ESTIMATED OPERATING COST OF PROPOSED 42-IN. VERTICAL BORING MILL TO BE INSTALLED AT AN INVESTMENT OF $7,500

Interest on investment: $7,500 at 6 per cent	$450.00
Depreciation: $7,500 at 5 per cent	375.00
Maintenance: $7,500 at 4 per cent	300.00
Insurance and taxes: $7,500 at 3 per cent	225.00
Labor: 85c. an hour, 2,400 hours a year	2,040.00
Power: 36,000 horsepower-hours at 2c	720.00
Oil, waste and grease	50.00
Total annual operating cost	$4,160.00

In the hands of an average machinist and under ordinary working conditions, it is demonstrable that a yearly production of 2,700 units can be obtained from the proposed new equipment, as compared with 900 units now secured from the present machine. The cost per piece will therefore be reduced from $3.50 to $1.54. The total expense to manufacture 2,700 units with existing facilities would be $3.50 × 2,700 = $9,450, as against $4,160; consequently the proposed new 42-in. mill would effect a net saving of $5,290 a year. This saving is a return of 70 per cent on an investment of $7,500.00.

Before statements of this character are presented to the management, care should be taken to verify all figures and in such a case as that just set forth, it is of vital importance to prove beyond question that the proposed new machine has an actual productive capacity of 2,700 units a year and that this figure is not a mere assumption. It may be possible that a machine of the proposed type is in service at some point on your railroad or perhaps in the shop of a neighboring road. In either event its average capacity can be readily determined. Machine tool manufacturers are always glad to indicate where their equipment may be observed in service and to be of any possible assistance in demonstrating its economic advantages.

When Expenditure Is Not Warranted

A mistake is frequently made in assuming that it is always a profitable investment to replace old machine tools with new equipment. When a careful analysis of the proposition is made it may be found that owing to abnormal conditions in the machinery market the cost of new tools is excessive. The investment is thereby increased so as to make capital charges, such as interest, depreciation, maintenance, etc., high enough to more than absorb all profit secured by increased production. This condition has been quite common during the past few years and will be more clearly understood by a study of the comparative cost to operate an old 84-in. driving wheel lathe installed at a total cost of $7,200 and a modern 90-in. machine representing an investment of $34,000.

ESTIMATED OPERATING COST OF OLD 84-IN. DRIVING WHEEL LATHE

Interest on investment: $7,200 at 6 per cent	$432
Depreciation: $7,200 at 5 per cent	360
Maintenance: $7,200 at 4 per cent	288
Insurance and taxes: $7,200 at 3 per cent	216
Labor: machinist and helper at $1.27 an hour, 2,400 hours	3,048
Power: 45,000 horsepower-hours at 2 cents	900
Oil, waste and grease	80
Total operating cost	$5,324

We will assume that the old 84-in. lathe has a capacity of four pairs of drivers a day. This is equivalent to a total production of 1,200 units a year. As the annual operating expense is estimated at $5,324, it follows that the cost to turn a pair of drivers on this machine is approximately $4.44.

A modern 90-in. driving wheel lathe installed at an expense of about $34,000 has a capacity of about seven pairs of drivers a day, under average working conditions. The operating cost may be estimated as follows:

ESTIMATED OPERATING COST OF 90-IN. DRIVING WHEEL LATHE

Interest on investment: $34,000 at 6 per cent	$2,040
Depreciation: $34,000 at 5 per cent	1,700
Maintenance: $34,000 at 4 per cent	1,360
Insurance and taxes: $34,000 at 3 per cent	1,020
Labor: machinist and helper at $1.27 an hour, 2,400 hours	3,048
Power: 72,000 horsepower-hours at 2 cents	1,440
Oil, waste and grease	120
Total operating cost	$10,728

On the basis of an output of seven pairs of drivers a day, corresponding to a production of 2,100 units a year, the expense to turn a pair of drivers on this machine will be approximately $5.11. Inasmuch as the present cost is only $4.44 it is not possible to show that the proposed installation of a new 90-in. machine would be a profitable investment; at least not unless the investment can be considerably reduced.

Manufacturing Versus Purchasing

A frequent problem, arising in connection with the management of railroad shops, is that presented, usually by the purchasing department, when it asks whether it would be cheaper to manufacture or purchase a given article.

This question could of course be readily answered with the assistance of a suitable cost accounting system. In the absence of such a system the only accurate method of determining the total cost of manufacturing an article is to study carefully the time consumed in the various operations, the total investment represented by machinery and floor space, the percentage of supervision and other overhead expense properly chargeable to this account. If these items are given their correct value, together with the cost of whatever raw material is used, it will be possible to arrive at a reasonable approximation to the cost of manufacturing any article.

Certain complications frequently enter into these problems, particularly with respect to the proper capital charges to be made on the investment in machinery, buildings, etc., used for railroad manufacturing. Where these facilities are provided for this purpose only there can be no question as to the distribution of fixed charges. It is usual, however, to find that the machinery, buildings, etc., are normally a portion of the railroad's plant, primarily installed for the upkeep of locomotives and cars. The manufacturing proposition enters as an afterthought, due to the fact that there is not enough repair work to utilize the machine tool equipment up to its full capacity. Under these conditions, where capital charges have already been fully taken care of in the railroad company's books as an operating expense it would not be proper to enter them again as an item in any estimate of manufacturing cost.

Consequently, when otherwise idle machinery is utilized for local manufacture a railroad shop enjoys a considerable advantage, owing to the partial elimination of capital charges on this machinery. In many cases, however, this advantage is more than offset by the obsolete and inefficient condition of railroad shop machine tools and by the fact that these shops are not usually organized to compete with industrial establishments.

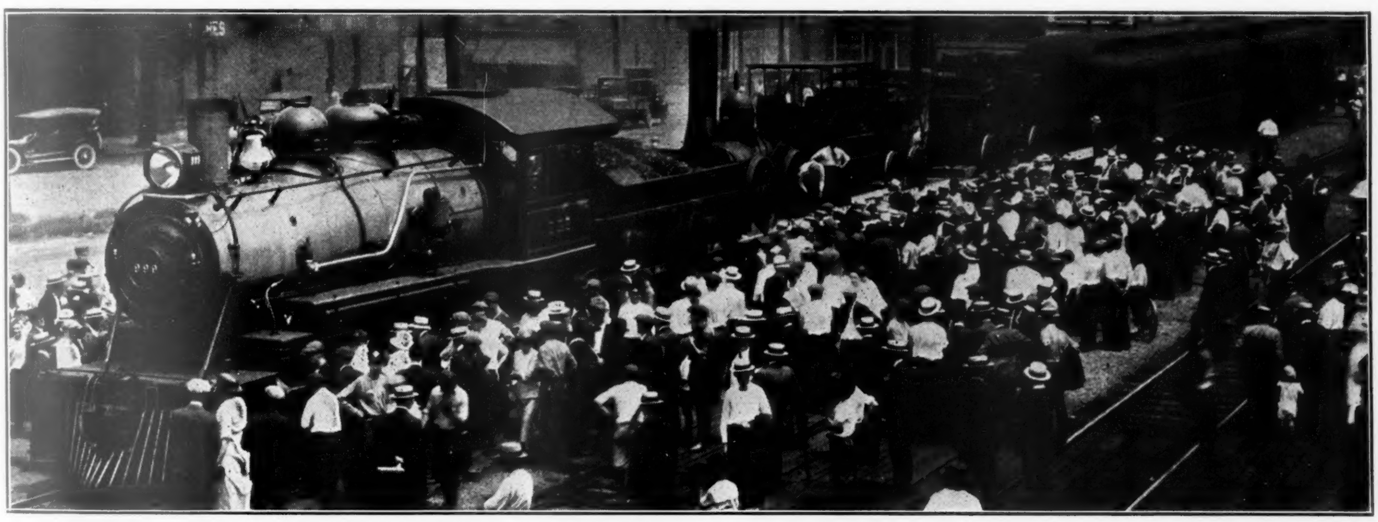
It will, therefore, be apparent that in the continued operation of antiquated machinery, railroad companies are penalized in various ways: viz.—heavy additional expense in machining repair parts, inability to compete with industrial concerns in the production of finished material, and the psychological effect upon shop mechanics compelled to witness a constant waste, leading to the inefficient performance of their daily tasks.

The "DeWitt Clinton" Moves Under Its Own Power

The locomotive DeWitt Clinton, and its three coaches, the historic New York Central passenger train, which for the past year has been on exhibition in the Grand Central Terminal, New York City, was taken to Chicago a short time ago to be exhibited at a pageant of progress exhibition held in that city.

For a short section of this journey the old locomotive was moved under its own power. For the rest of the trip the ancient train was carried on platform cars in a special train drawn by locomotive No. 999, which was one of the notable engines built for the New York Central by William Buchanan, 38 years ago, when the Empire State Express was first making its reputation. The illustration of this special train on this page is from a photograph taken at Erie, Pa. The 999 has been remodeled, since it was in service on the main line, and during recent years it has hauled passenger trains on the Pennsylvania division. For this special trip the tender was again painted and decorated in the style which was familiar to passengers at the time of the World's Fair in 1893.

The first trip made by the DeWitt Clinton with a passenger train was from Albany to Schenectady on August 9, 1831, so that the exhibition at Chicago marks the ninetieth anniversary of the life of the locomotive. In its present condition the locomotive weighs 9,420 lb. and the tender 5,340 lb. A standard New York Central Pacific type passenger locomotive, now in use, such as that shown in the illustration, weighs 276,000 lb., or about 11 times the weight of the entire train of 1831; though the gage of the track is the same now that it was then.



The "999" with the "DeWitt Clinton" at Erie, Pennsylvania

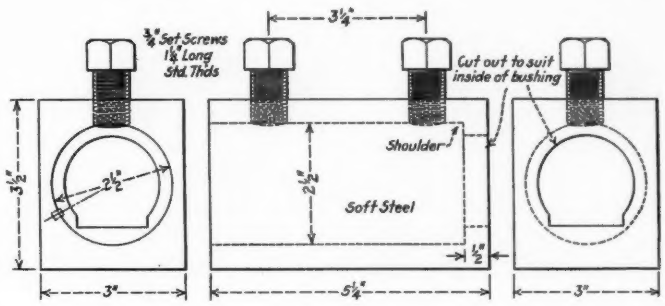
The DeWitt Clinton continued in active service for a period of 14 years. It hauled its trains at a maximum speed of 30 miles an hour on its first trip; but as fired up for the present exhibition it has been moved at only about eight miles an hour, no attempt being made other than to show that it was still in running condition.

Jig for Machining Reversing Valve Bushing Seats

BY J. H. HAHN

Assistant Machine Shop Foreman, Norfolk & Western, Portsmouth, Ohio

The illustration shows a jig to be used on the shaper for refinishing the seats of reversing valve bushings in 8½ in. cross compound air compressors. These seats wear rapidly in service and by removing the bushings from the top heads and placing them in the jig shown, the seats can be trued up very quickly. Extra large reversing valves which are now being furnished by the Westinghouse Air Brake Company can be fitted to these bushings, the whole operation being done in a few minutes. Large numbers of reversing valve bushings can be repaired or reclaimed by this method. The design and use of the jig is plainly shown. The jig is first chucked in the vise on the shaper table and the bushing inserted, the two set screws being tightened down just hard enough to hold the bushing and a special tool used to machine the seats. The jig is provided with a dowel pin to fit the key-way in the bushing which corresponds with the dowel pin in the top head of the air pump, thus holding the bushing in a central position and preventing any liability of its turning while it is being machined.



Jig for Holding Reversing Valve Bushings of 8½-In. Cross Com-

In making the jig a good deal of work can be eliminated by merely cutting off one end of an old reversing valve bushing and placing it in the end of the jig, securing it with screws or rivets. This will make it unnecessary to machine the end of the bushing to conform to the shape of the seat in the reversing valve bushing. Of course, this guide or shoulder in the end will have to be low enough to clear the tool when machining thinest seats which occur in worn bushings.

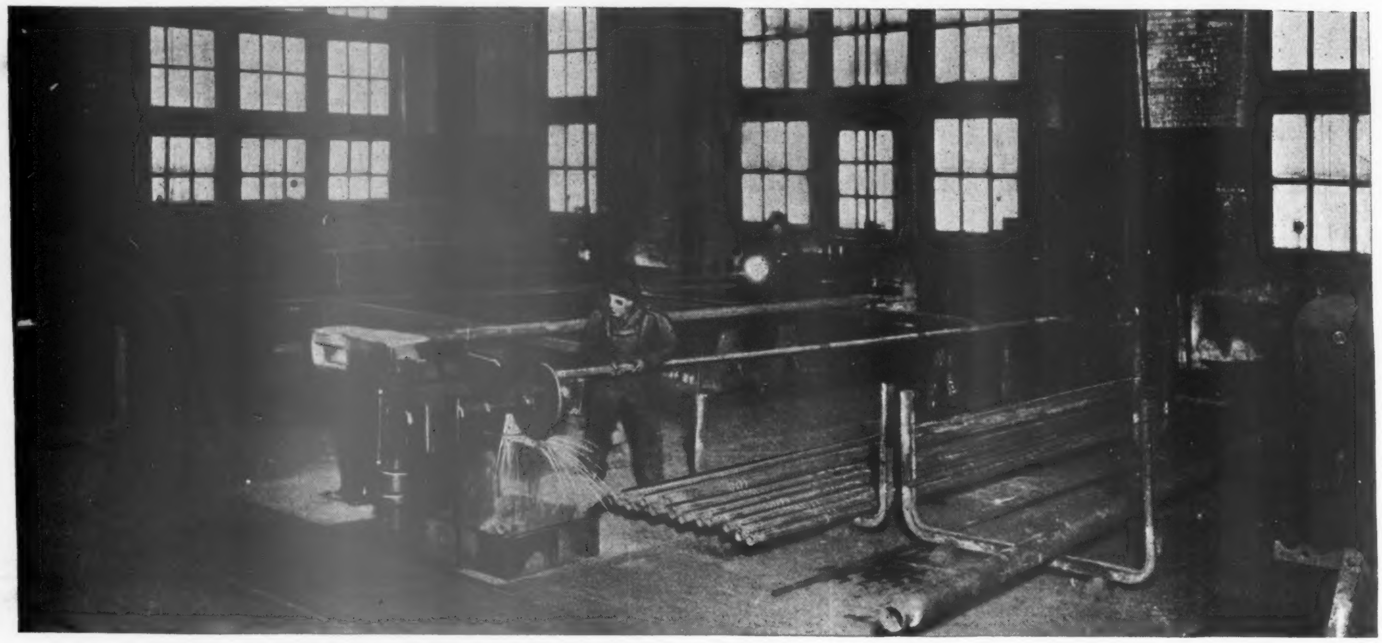


Fig. 1—General View of Delaware, Lackawanna and Western Flue Shop at Scranton, Pa.

Modern Equipment Facilitates Flue Shop Work*

A Description of Machinery and Methods Effective in Speeding Up the Safe Ending of Boiler Tubes

Methods of reclaiming and safe ending standard locomotive tubes and superheater flues employed in the Scranton shops of the Delaware, Lackawanna and Western represent the latest developments in this important phase of locomotive maintenance work. All machinery in the flue shop is of the most advanced design and is so arranged that flues follow from one stage to another with a minimum of handling and with a staff of only four men to operate the equipment.

WITH a normal output of about 800 to 900 safe ended standard size tubes in an eight-hour day, the flue department of the Delaware, Lackawanna and Western shops at Scranton, Pa., has a production record that has justified the far sighted policy of the management in scrapping obsolete shop equipment and installing the most modern tools available. When the road was returned to the control of the company in 1920 after its release by the government it was decided that economies in the flue shop could be effected by the installation of an entirely new set of equipment. To this end engineers of Joseph T. Ryerson & Son, Chicago, with the co-operation of the railroad engineering staff, developed a flue shop layout that has greatly increased the operating efficiency.

Location of Shop

The flue department occupies a space about 110 ft. by 60 ft. in the south end of the west bay of the boiler shop, which is made up of four departments. The west bay contains an erecting shop and the flue shop; the two center bays are occupied by light and heavy machine tool equipment, storerooms, plate shops and the like, while in the east bay is located a second erecting shop. Part of the space in the flue shop, used for tube storage, can be adjusted to suit the requirements at any particular time, depending on the number of locomotives in the shop.

The buildings are of brick and steel construction with glass walls, making it possible for men to work under the most favorable natural lighting conditions. The shops are piped with air, water, oxygen and water gas for operating tools and heating furnaces. The east and west bays in which the erecting shops are located are each served by two Shaw electric cranes, one of 150 tons capacity and the other of 20 tons.

When an engine comes into the shop for repairs, it is dismantled and the tubes and superheater flues are cut out in either one or other of the erecting shops. The operation of cutting out the small tubes and superheater flues is done by means of air driven expanding cutters. The back ends of the tubes are cut out with an air hammer and the tubes passed out through the front tube sheet. They are then piled in racks until the entire set has been removed from the engine. In the west erecting shop, rope slings are passed around a bundle of tubes, which is then picked up directly by one of the cranes and taken to the flue department. In the east erecting shop the tubes are piled on trucks and transferred across the shop to the flue department, where the crane picks them up and deposits them in storage racks until they are put through the reconditioning processes.

Operations Carried Out in the Flue Department

Four major operations are carried out on tubes in the flue shop. They are cleaned, safe ended, short tubes are reclaimed and superheater flues safe ended. The machines are laid out

*From an article in the August issue of The Boiler Maker.

as in Fig. 2, to carry out each of these operations, or combinations of several of them, without interference and with the least possible handling.

The cleaning operation, which is the first process through which all tubes pass when brought to the department, is carried out in a Ryerson underground pit type cleaner, Fig. 3, which has a capacity of 350 2-in. flues up to 24 ft. in length at one time. In charging the cleaner, an entire set of flues is slung in chains and lowered by one of the shop cranes onto the rolling chains in the pit. The ends of the sling chains are fastened to hooks in the sides of the pit and remain hanging free from interference with the tubes in this position until after the operation is completed. Five sets of silent roller chains are fitted in the tank of the cleaner. Power is transmitted to the drive shaft through a silent chain by a 25-hp. motor. When the tubes are in place the tank is partly filled with water and the motor started. While the chains are in motion, the tubes are drawn through the water and partly up one side of the tank, where a draining action takes place and the tubes are tumbled back into the water and the process repeated, thus keeping them in constant agitation until absolutely clean. From two to six hours are required to clean tubes, depending on the hardness and thickness of the scale and on the water district in which they had been operating. One feature of the cleaner is that even while it is in operation the noise is practically eliminated and because the covers are flush with the floor the movement of materials in the section occupied by the cleaner is in no way held up. This is a big improvement over the common barrel type cleaner as the latter is usually located outside the shop. Such a location prevents handling all the tubes together by crane and keeps two men constantly busy loading and unloading the barrel cleaner.

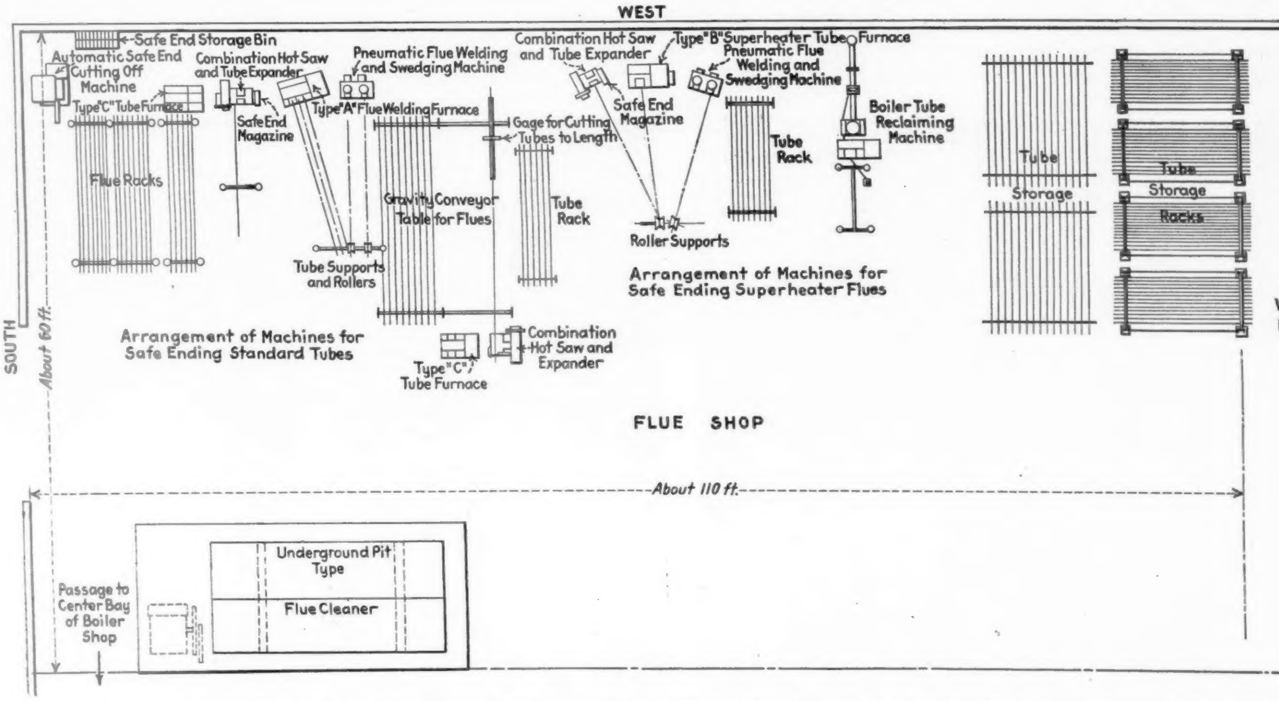


Fig. 2—Arrangement of Machinery and Equipment for Safe Ending Locomotive Boiler Tubes and Superheater Flues

After the tubes are cleaned the ends of the sling chains are picked up by the crane and the bundle of tubes removed to the racks near the first heating furnace. There is no direct

Fig. 3—Underground Type Tube Cleaner with Covers Raised

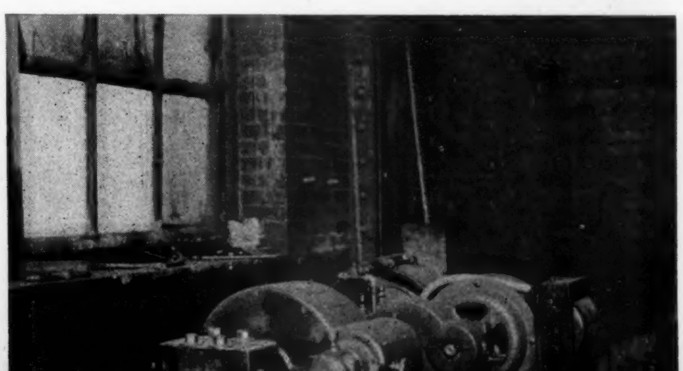


Fig. 4—Automatic Safe End Cutting Off Machine

labor charge in the cleaning of flues in the D. L. and W. shops, for the entire work of loading and unloading the cleaner is completed by the shop crane, usually under the direction of the fourth man of the repair unit. Not more than ten minutes' crane time is required for handling the tubes in this department. The cleaner will also turn out a set of forty-five 5⅜-in. superheater flues in the same time required for standard tubes; that is, from two to six hours.

The remaining machinery on the floor also is of Ryerson make, segregated in three sections with sufficient space between each unit so that the work may be carried on without interference. The standard 2-in. to 2¼-in. tube safe ending layout has for equipment two type "C" special tube furnaces, two combination hot saw and tube expanding machines (one with a safe end magazine), one type "A" flue welding furnace and one flue welding machine, occupying a section along the west side of the department about 40 ft. by 30 ft. In connection with the safe ending work an automatic safe end cutting-off machine is located in one corner of the shop.

Fig. 5—After Heating, the Fag Ends of Tubes Are Cut Off, Expanded and Safe Ends Inserted on This Machine

Fig. 6—Tubes Are Heated to the Welding Point, and Then Welded and Swedged on This Double Pneumatic Hammer

In the section devoted to the safe ending of superheater flues are one type "B" flue welding furnace; one combination hot saw and tube expanding machine with a superheater safe end magazine and one pneumatic flue welding machine and swedger.

Between the superheater section and the storage racks at the end of the department is a boiler tube reclaiming machine, used in reclaiming tubes not possible to handle in the standard 2 to 2¼-in. repair equipment.

Preparing Safe Ends for Welding to Tubes

The first step in the actual safe ending of the tubes is the cutting of stock tubing into safe ends of suitable lengths. The cutting machine for doing this work is automatic in operation and requires attention only when tubes are started in the feeding mechanism. Standard tubes from 1½ in. to

Fig. 7—The Entire Safe Ending of Boiler Tubes Is Carried Out on the Equipment Here Shown To Cut the Tubes to Length an Additional Heating Furnace and Combination Hot Saw and Expanding Machine Are Used

3 in. up to about 25 ft. in length can be fed into the machine. In general, the machine consists of a cabinet base on which is mounted an automatic, pneumatic chuck for gripping the tube; a cam feed cutting-off tool for cutting the tube to the proper length of safe end and, at the same time, scarfing the tube; a feeding device for moving the tube through the hollow spindle and a cutting compound circulating system. The operation consists of placing the tube in the hollow spindle, and when the machine is started, the air valve is opened by a cam and the chuck automatically grips the tube and rotates it with the spindle; the cutting tool meanwhile feeds up and cuts off the tube. The feeding chuck

Fig. 8—Machines for Safe Ending Superheater Flues Are Located So That the Operator Has to Move the Tube Only a Slight Distance to Complete All the Operations

at the rear of the spindle then grips the tube and feeds it forward for the next cutting operation.

Safe ends ready for use are stored in racks adjacent to the cutting-off machine.

Process of Safe Ending Standard Tubes

When a set of tubes is ready for safe ending, after going through the cleaner, the shop crane places the bundle on a storage table near the heating furnace. The speeds of all operations on the tube preparatory to welding on the safe end are adjusted to the time taken up by the actual welding and all operations required after this are regulated by the speed of the welder. Tubes are fed by gravity down the storage table to a position near the furnace and the operator at this point, who controls the heating, places the fag ends of six tubes in the fire where they are heated to a cherry red. This furnace, a Ryerson type "C," is especially designed for use in conjunction with the hot saw and expanding machine. Although this type of furnace is generally equipped with oil burners adjusted for an oil pressure of 45 lb., in the D., L. & W. shops water gas is used for heating all furnace equipment throughout the entire plant. The capacity of the type "C" furnace is six 2-in. tubes or three 4-in. tubes at one time.

From the furnace, the tubes are pushed against the hot saw by the operator and the fag ends cut off. At the end of the shaft on the hot saw, a reamer is attached which is used to burr out the inside of the tube end and chamfer the outside edges. This same attachment is applied to all hot saw machines in the shop.

While the tube is still at a red heat the same operator places it in the expanding machine, Fig. 5, then removes it when expanded and inserts the tube, still hot, over a safe end which is dropped into place from the magazine. The three operations on the combination hot saw and expanding machine can be accomplished in about 12 seconds. The machine consists of a substantial base on which is mounted a small high speed saw, a pneumatic clamp and expander which operate independently, and a magazine in which the safe ends are fitted. Fag ends from the sawing operation drop into a small chute which is provided and are carried to a waste pan. The clamp for holding the tube in place for expanding has a lower stationary fluted jaw and an upper jaw mounted on a lever, connected with a pneumatic cylinder. Back of the tube clamp is placed a horizontal cylinder with a piston rod having a taper mandrel extending toward the center of the jaws of the clamp. In carrying out the operation, a control lever on the right of the clamp is thrown into action and the valve controlling the cylinder is opened, forcing the upper jaw down and clamping the tube in place. As the throttle lever is drawn towards the operator, the valve controlling the horizontal cylinder is opened and the expanding mandrel forced into the end of the heated tube. When the lever is thrown back, the plunger recedes and at the same time a safe end is dropped into place from the magazine; simultaneously the clamping jaw opens and releases the tube which is then shoved over the safe end and is ready to go into the furnace for welding. The machine operates at an air pressure of about 80 to 100 lb. and only about 3 hp. is required for the driving motor. The standard tube machine will accommodate tubes from 1½ in. to 3 in. in diameter.

Welding the Safe End

From the time the safe ended tube is put into the welding furnace, the second operator has charge of it. The type "A"

Fig. 9—As in the Case of Small Tubes the Superheater Flues Are Welded and Swedged on a Double Pneumatic Hammer Which Operates at 80 to 100 Lb. Pressure.

furnace has three openings and will heat three 2 or 2¼-in. tubes simultaneously. Instead of oil burning equipment with which the furnace is generally equipped, gas burners have been fitted. When the proper welding heat has been reached, the operator places the safe ended tube over the mandrel in the pneumatic flue welding machine, Fig. 6, rotating it under the hammer until the joint is properly made. While still hot, the tube is moved to the right-hand cylinder of the machine for swedging. The double cylinder machine used consists of a heavy iron cabinet base on which is mounted the hammer mechanism. Separate foot levers control the welding and swedging hammers so that while the welding is being done,

the cylinder and dies used for swedging are idle, thus keeping the air consumption low. Different size dies permit tubes from 2 in. to 4½ in. in diameter to be welded. Mandrels can also be fitted to the machine so that it is possible to weld safe ends from about 3 in. to 12 in. in length. Tube dies are attached to the lower end of the piston with a key and travel in the guides of the upper frame. The operation of the piston is similar to that of an air hammer. The lower dies are held in a steel frame and all dies are so designed that they fit the outside of the flue with the proper allowance for expansion when heated. A scale scraper is fitted on the right-hand side of the frame near the lower die.

Cutting the Tube to Length

The final operation in reconditioning the tube is the cutting off of the smokebox end of the tube. The tubes roll along gravity racks from the welding machine to the third operator who places the ends in a second type "C" furnace where they are heated. As in the case of the first cutting off heating furnace, this furnace has a capacity to hold six tubes at once. When heated to a cherry red, the operator allows them to roll onto a rack having a gage at one end adjusted to the length required of the finished tube. He then places the heated end against the hot saw and after cutting off moves it to the expander. The tube is finally placed in a rack ready for installation in a locomotive in the erecting shop. Throughout the entire process the tubes are never turned nor reversed in direction. It may be said that the tubes are practically in motion from the time they leave the first rack until they are repaired and again ready for installation in an engine.

Machinery for Safe Ending Superheater Flues

The section of the shop devoted to welding safe ends on superheater flues is arranged in a slightly different manner from the small tube department as will be seen from the floor plan shown in Fig. 2. When a set of tubes is brought to the department and placed in the racks after cleaning, the operator places a single one of them in a type "B" welding furnace until it is heated to a cherry red. The three pieces of equipment in this department are arranged in an arc of a circle so that a tube supported at its outer end on a roller stand may be moved by the operator from the furnace to the hot saw, expander, and safe end magazine, and back to the furnace for the welding heat and finally to the welding and swedging machine by simply supporting the weight of the tube end on which the work is being done. The superheater flue welding furnace burns gas for fuel and will take tubes up to 6 in. in diameter. The combination hot saw and tube expanding machine is similar to that used in the layout for standard size tubes except that its capacity is for flues up to 6 in. in diameter. A five hp. motor is required to operate this machine. In the case of the pneumatic welding machine the capacity is for tubes from 2 in. to 6½ in.

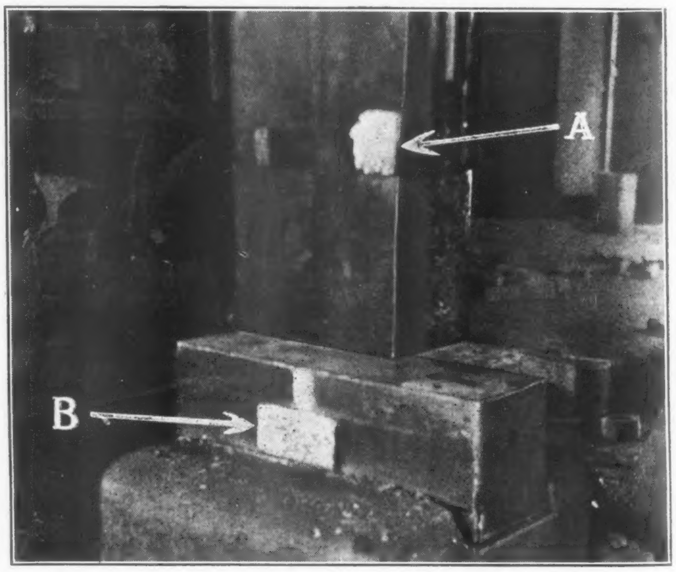
Reclaiming Short Length Flues

The practice of the D., L. & W. is to apply not more than two safe ends on tubes or flues. When tubes removed from a boiler have been pieced twice, they are either cut down and used on smaller engines or have a single long tube welded on the end in the flue reclaiming machine. Flues to be reclaimed are scarfed, expanded and placed in racks adjacent to the reclaiming machine. This equipment consists of a special pneumatic welding machine of the hammer type, an oil heating furnace and a special mandrel on which the tube is placed as shown in the arrangement plan of the shop. In this operation the tube is heated in the usual way, and the short tube used to piece out the length inserted. The tube and end are then passed through the furnace and over the mandrel until the point of weld is in the proper place for heating. When the required heat is reached the tube is moved forward through the furnace to the welding dies, the hammer being in direct line with the furnace opening. A stop is arranged on the mandrel which acts as a gage to locate the welding point. When the farther end of the tube strikes this stop it operates a lever which in turn actuates the air valve of the welding machine thus automatically beginning the welding operation. As soon as the pressure of the tube is taken from the gage stop, the air supply is cut off and the welding machine comes to a standstill. The tube is then pulled back through the furnace completing the operation. Finished tubes from each department are arranged in sets containing the proper number for installation in a locomotive and picked up by the shop crane and piled in storage racks.

Steam Hammer Repair

BY W. E. GIBBS

The illustration shows two thermit welds made on a steam hammer bottom die and head, enabling a 3,200-lb. hammer to be returned to service quickly at a minimum of expense. The steam hammer developed a bad crack where the upper die is keyed to the head, as shown at *A*. The head was removed from the hammer, the crack being burned out with the oxy-acetylene cutting torch and the surfaces chipped and cleaned for welding. The head of this hammer is 9¼ in. thick, 18⅝ in. wide and 51 in. long and on account of the severe service to which it is subjected, special care was taken in making the weld. After the weld was made, the head was machined and placed back in service, the hammer being ready for operation in a few days. One hundred pounds of thermit was used in making the weld, which required about



Cracked Head and Bottom Die as Repaired by Thermit Welding

ten hours' work. As the weld was made some time ago, it was necessary to have it chalked in order to show up.

The bottom die head on this steam hammer broke squarely in two pieces at *B*. The die was placed on the surface table and lined up in the proper position, a 1¼ in. nut being placed in the center of the die between the two sections to allow proper space for the thermit steel. A strong clamp was placed around the outside of the flask. The thermit weld was poured and on cooling off, the reinforcement on the upper portion of the die was machined off to make the upper and lower dies square with each other. One hundred and fifty pounds of thermit were used in making this weld, which has given satisfactory service for eight months. The die is 10 in. wide by 11 in. thick and 30 in. long.

This steam hammer is subjected to unusually heavy duty and is in constant use forging open hearth steel up to 6 in. by 20 in. in cross section.

Labor Board Settles Overtime Controversy

Seven New Rules to Govern Punitive Payments; Hearings on the Re-establishment of Piece Work

SEVEN new rules, recognizing and continuing the principle of punitive pay for overtime work in railroad shops, have been promulgated by the Railroad Labor Board as the solution of one of the stumbling blocks in the negotiation of new agreements regarding rules and working conditions between many railroads and their shop employees. These new rules, which are effective as of August 16 and are retroactive to July 1, also recognize and sanction the principle of the eight-hour day, the policy of paying time and one-half for work performed on Sundays and holidays except that work which is absolutely essential to continuous operation and the practice of paying an allowance to an employee called but not required to work. On the other hand, the provisions of the seven new rules so change the overtime rules in the Shop Crafts Agreement that several of the wasteful and ridiculous effects brought to the attention of the Board during the hearings on national agreements will not be continued.

The new rules are to take the place of Rules 7, 9, 10, 12, 14 and 15 of the Shop Crafts National Agreement. The changes which have been made are briefly outlined in the following paragraphs. In all other respects the rules have been unchanged.

Rule 6

Instead of paying all shop employees time and one-half for Sunday and holiday work as was necessary under Rule 6 of the Shop Crafts Agreement, the new rule prepared by the Board provides that "employees necessary to the operation of power houses, mill-wright gangs, heat treating plants, train yards, running repair and inspection forces, who are regularly assigned by bulletin to work Sundays and holidays, will be compensated on the same basis as on week days." The new rule also contains the interesting phrase, "Sunday and holiday work will be required only when absolutely essential to the continuous operation of the railroad."

Rule 7

Rule 7 of the Shop Crafts Agreement has been changed so that instead of receiving a guarantee of one hour's pay for 40 minutes or less continuous overtime service with the right to go to meals after one hour's work, the shop employee will be paid time and one-half on an actual minute basis with a minimum of one hour, and he can be held for two hours before going to meals. The time then taken for meals will not terminate the employee's continuous service and must be paid for up to 30 minutes.

Again, instead of receiving five hours' pay for three hours and 20 minutes service or less when called to return to work the employee is to be paid a minimum of four hours for two hours and 40 minutes or less work. This four hours' pay must also be paid to employees called but not used.

During the course of hearings on the national agreements the railroads objected particularly to the provision of the old rule which allowed the employee to collect 10 or 15 hours' pay on the ground that, when he had completed the task for which he was called, his assignment to other emergency work constituted a second and sometimes a third call. To offset this the new rule says: "Employees called * * * will be required to do only such work as called for *or other emergency work which may have developed after they were called and cannot be performed by the regular force in time to avoid delays to train movement.*"

The new rule also makes provision for paying employees time and one-half on an actual minute basis with a minimum of one hour for work performed in advance of the regular working period.

Rule 9

Rule 9 in the Shop Crafts Agreement gives the employee who works through his lunch period one hour's pay and the opportunity to procure his lunch later without loss of time. The new rule gives him but straight time and the opportunity to procure his lunch later without loss of time *up to 30 minutes.*

Rule 10

The railroads protested the provisions of Rule 10 of the Shop Crafts Agreement which enabled shop employees, sent out on the road for emergency service, to receive, under certain conditions, time and one-half for time spent in waiting for trains or in traveling. The new rule prepared by the Board eliminates these provisions, giving the employee on such work straight time for all time waiting or traveling.

The time of the employee sent out for such service was formerly reckoned from the time called until his return, but under the new rule his time begins when he leaves his home station.

Again, when such emergency service kept the employee on the road for several days, including either Sundays or holidays, he was guaranteed eight hours pay for week days and time and one-half for Sundays and holidays. Under the provisions of the new rule he is guaranteed but eight hours pay for each calendar day.

The new rule also provides that when an employee is required to leave his home station during overtime hours he will be allowed one hour's pay as preparatory time.

The following provision for wrecking service employees is added to the new rule:

"Wrecking service employees will be paid under this rule, except that all time working, waiting or traveling on Sundays and holidays will be paid for at rate of time and one-half, and all time working, waiting or traveling on week days after the recognized straight-time hours at home station, will also be paid for at rate of time and one-half."

Rule 12

Changes similar to those made in Rule 10 are made in Rule 12, the provisions of which apply to employees sent out to fill temporary vacancies at outlying points. The railroads particularly objected to the last paragraph of Rule 12 of the Shop Crafts Agreement, which continued those rules more favorable to the employees in older agreements. The new rule contains no provision for the continuation of these older rules.

Rule 14

Those shop employees regularly assigned to road work who have been paid, under Rule 14 of the Shop Crafts Agreement, straight-time for their regular hours and time and one-half for all overtime hours whether working, waiting or traveling will, under the revised rule, receive straight time for all hours traveling, waiting or working during regular hours and time and one-half only for work performed during overtime hours.

The new rule also contains the following paragraphs which are not included in the old rule.

"Where meals and lodging are not provided by the company when away from home station, actual expenses will be allowed.

"Where employees are required to use boarding cars, the railroad will furnish sanitary cars and equip them for cooking, heating and lodging; the present practice of furnishing cooks and equipment, and maintaining and operating the cars, shall be continued."

The starting time in both the old and revised rules is set at from 6 a. m. to 8 a. m. However, the following exception is included in the new rule:

"In case where the schedule of trains interferes with the starting time an agreement may be entered into by the superintendent of the department affected and the general chairman of the craft affected."

Rule 15

Rule 15 of the Shop Crafts Agreement has been changed to conform to the Board's decision relative to the payment of time and one-half for work performed on Sundays and holidays inasmuch as this rule applies to employees regularly assigned to road work and paid on a monthly basis. Whereas formerly the monthly rate of these employees was determined by dividing 3,156 hours, which includes 59 Sundays and holidays at time and one-half, by 12, their monthly rate is now to be deducted by dividing 2,920 hours, or 365 eight-hour days, by 12.

The new rule also contains the following paragraphs which will eliminate some of the features to which the carriers have strenuously objected:

"The regularly assigned road men under the provisions of this rule may be used, when at home point, to perform shop work in connection with the work of their regular assignments.

"If it is found that this rule does not produce adequate compensation for certain of these positions by reason of the occupants thereof being required to work excessive hours, the salary for these positions may be taken up for adjustment."

Board Outlines Its Opinions on the Subject of Overtime

The Board in handing down these new rules said in part:

There was a wide diversity of rules among the numerous railroads of this country prior to the standardization that took place during federal control. It is therefore possible to cite precedents for almost any rule that may be advocated. Such precedents, at best, are persuasive, but not controlling. The fact that a given rule may once have existed by agreement on a road is not conclusive of its reasonableness and justness, for it may have been imposed on the employees by unavoidable necessity or on the carrier by economic pressure. The Board has therefore felt constrained to consider the principles of right and wrong involved in the proposals and counter-proposals submitted to it, in the light of present conditions and industrial history.

Throughout these rules, the soundness of the principle of punitive pay for overtime work has been recognized, but not to the extreme extent embodied in the National Agreement.

The eight-hour day has also been given full recognition. The policy of paying time and one-half for work performed on Sundays and holidays is also approved in Rule 6, but an important exception is provided. Certain kinds of work, which are unavoidably and regularly performed on Sundays and holidays and which are absolutely essential to the continuous operation of the railroad to meet the requirements of the public, are not treated as overtime work. The carrier has no choice as to the performance of this work, and does not arbitrarily require it. It is not just to penalize the carrier for that which it cannot escape. Manufacturing plants can, as a rule, control or eliminate Sunday and holiday work, therefore, a comparison of such plants with a railroad is unfair, except in so far as the "back shop" is concerned, and the method of paying for overtime in the back shop has not been disturbed by these rules.

There are other classes of employment in which Sunday and holiday work is regular and necessary, and those engaged in it are not paid overtime; for example, engineers, firemen, conductors, and trainmen, and, going outside of railroad service, police and fire department employees, and street car conductors and motormen.

The practice of allowing five hours for a call is a relic of the time when ten hours constituted a day's work, and it was thought just and reasonable to allow one-half day, or five hours, for a call. Now that the hours have been reduced to eight, by the same principle, it is just and reasonable to make the allowance one-half day or four hours.

Employees usually commence work between 7 a. m. and 7.30 a. m., with a lunch period in the neighborhood of 12 o'clock noon, and finish their regular eight-hour period at 4 p. m. Certainly, there is no hardship in asking employees to continue on to 6 p. m. (if their services are required) before they go to a meal, and in many cases workmen would prefer to work the additional two hours in order to complete their work and go home without having to return.

If men are called after regular hours for some emergency work, it is fair and reasonable to use these men only on other emergency work which may have developed after they were called without being obliged to call them again or to call other men.

When men are sent out on the road for emergency service, or to fill temporary vacancies, it is certainly just and reasonable to pay them straight time for all time traveling or waiting, and for all time worked, straight time for straight-time hours, and overtime for overtime-hours in accordance with the practice at the home station or at the point where they are temporarily employed.

It is just and reasonable that men assigned to road service on a monthly basis should be paid eight hours per day, 365 days per year, without any allowance for overtime.

It is a fact that on many Sundays and holidays these men are not called upon to work, but no deduction is made in their pay. These monthly positions must be desirable because they are usually occupied by the older men, and there is regularity as to the monthly compensation.

The Board has felt impelled, however, to decline many of the modifications of said rules advocated by the carriers, because they appeared to go to an opposite extreme that is unjust and unreasonable. In this case, as so often happens in human experience, there is a point somewhere between the extreme positions of opposing forces where justice and reason may be found.

The rules above set out will become effective August 16, 1921, except that employees who have been paid under a less favorable rate or condition for the period embracing July 1 to August 15, 1921, inclusive, shall be reimbursed under these rules.

Dissenting Opinion of A. O. Wharton

For the first time in the history of the Labor Board a dissenting opinion accompanied the decision. A. O. Wharton, labor representative on the Board, in a lengthy argument opposed the decision of the majority on the grounds that "it does not appear either just or reasonable that conditions that have been in effect from 10 to 20 years and even longer, established as a result of negotiation and mutual agreement between employers and employees, and not infrequently established where no organization of employees existed, can now be decided as unjust or unreasonable." In support of this contention Mr. Wharton cited the overtime provisions for the shop employees in effect on approximately 100 carriers prior to December 31, 1917, adding, "No charge was made by the carriers and no evidence submitted to the Board that would justify any statement to the effect that any of the rules resulting from negotiation between 1902 and December, 1917, were the result of an undue exercise of the economic strength of the employees' organizations."

Regarding the majority ruling as to straight time rates for Sunday and holiday work for certain classes of employees whose work is necessary to maintain continuous operation, Mr. Wharton said:

"As a matter of fact and recorded in the public hearings conducted by the Board, with representatives of the carriers present and not challenging the statement, overtime at the rate of time and one-half for Sunday and holiday work, and for work outside of the regular established day, has been in effect for this class of employees for not less than 40 years; it was voluntarily put into effect 20 years prior to the time the shop crafts had organization sufficient to negotiate working conditions."

After making several comparisons regarding practices of public utilities and municipalities regarding punitive payments for Sunday, holiday and overtime work, Mr. Wharton cited a compilation prepared by representatives of the Federated Shop Crafts and showing the overtime practices prevailing in 2,544 firms in practically all states of the union during 1920. This compilation shows that 869 of these firms paid double time for all overtime, that 2,270 paid time

and one-half or better for all time worked outside of regular hours and that but 49 paid straight time for all overtime.

"The plea that continuous service requirements should be a controlling factor in deciding that employees should be compelled to perform Sunday and holiday service for the same rate paid on week days," Mr. Wharton continued, "or that men should be assigned to duty 365 days per year, with millions of workers walking the streets in search of employment is a fallacy not sustained by any recognized authority qualified to pass . . . upon a question . . . associated with the social and moral well-being of the nation's workers."

Hearings on Piece-Work

Hearings on the subject of piece-work were begun for the Labor Board on August 8 and concluded on August 12. In the course of the proceedings, vice-chairman Hooper stated that the only question before the board was whether or not the rule prohibiting piece-work should be continued.

A large portion of the first day's testimony was taken up with a plea by B. M. Jewell, president of the Railway Employees' Department of the American Federation of Labor for separate hearings on each disagreement certified to the board during the past few weeks. J. G. Walber representing the eastern carriers stated that the railroads intended to rest their case largely on the testimony presented by the Conference Committee of Managers during the hearings on the national agreements. On August 9, the board announced that four days would be allowed to the employees to reply to the piece-work testimony of the Conference Committee of Managers and one day would be devoted to rebuttal statements from representatives of the railroads.

Committeemen representing the shop employees of 28 eastern and 26 western carriers appeared before the board on August 10 and vigorously protested the re-establishment of piece-work. Practically all of the local committeemen stated that from 95 to 100 per cent of the shop employees represented by them voted against the re-establishment of piece-work on the ground that this system of pay works a hardship on the employees, constitutes a form of slavery, prevents the payment of punitive overtime and makes impossible the payment of a living wage. Many of the committeemen based their arguments largely on the fact that the re-establishment of piece-work would wipe out their punitive overtime to a great extent and the introduction of this argument was protested by Mr. Walber, who called attention to the fact that the present hearings were on the question of piece-work. Mr. Jewell replied that the two subjects are so closely allied they must be considered together.

The hearings on August 10 and 11 were devoted principally to the presentation of an exhibit by Leland Olds on behalf of the Railway Employees' Department of the American Federation of Labor. This exhibit, entitled "The Problem of Piece-Work," dealt at length upon the "fluctuation" in earnings of shop employees under the piece-work system of pay. The attempt was made to attribute this "fluctuation" to conditions other than the workers' willingness or ability to produce by reference to disparities in the amounts earned by the same workers during various periods. The exhibit was divided into three parts, the first part of which is devoted to refutation of the evidence presented during the hearings on national agreements by the Conference Committee of Managers; the second part to a description "of what piece-work is in railroad shops," and the third part to the "comparative economy possible under the two systems."

Samuel Higgins, railroad representative on the board, in questioning Mr. Olds, brought out the fact that although the latter had entire charge of the preparation of this exhibit he is not a graduate of a technical school nor had he had any experience in railroad shops. Mr. Olds stated that he had depended for his experience upon the experience of the railroad employees who had supplied the material and arguments contained in the volume.

J. G. Walber Opens Railroad's Case

On April 12 John G. Walber, representing the eastern carriers, opened the testimony on behalf of the railroads by telling the board in substance that if the final decision of the board in this controversy results in preventing the carriers from doing work in their own shops except at excessive costs they will be forced to give their repair work to outside plants. In discussing the charges made by the employees, Mr. Walber said in part:

> Of all the charges of abuses and improper conditions under the piece-work system of pay there is none which cannot be corrected, if justified. The frequent charge that it is possible for employees to do inferior work and even fail to do work cannot properly be considered an argument against the system, as such a charge cannot be confined to piece-work and is equally possible under any other system of pay. If employees will neglect their work when paid on the piece-work basis, they will do the same on the hourly system, as the controlling element is the character of the individual.
>
> Whether or not the piece-work system of pay yields proper compensation for the work performed depends primarily upon the prices set for the jobs. With the prices properly set, we are unable to see what sound objection can be made to the system, if employees are willing to render adequate and proper services. The hourly system of pay allows no consideration for the industrious employee. All are on a common basis. It is the ambition of most energetic men to profit by their work; many have the ambition to engage in business for themselves. The piece-work system gives the employee this advantage and the ambitious, energetic employee receives compensation in proportion to his contribution to the output.

After urging the re-establishment of piece-work and the revision of piece-work rates to conform with changed conditions, Mr. Walber said:

> In such revisions, prices should be fixed which shall not impose excessive application of the employees in order to perform the jobs within the time used in fixing the unit prices, but if controversies arise as to the results of the unit prices, and it is not possible to amicably adjust them between the managements and the representatives of the employees, they can be referred to the Labor Board in accordance with the provisions of the Transportation Act. That act has come into existence since the piece-work system of pay was discontinued, so that today the employees have a Board to which they can appeal in the event any complaints against improper results cannot be adjusted on the home roads.

The rebuttal by the railroads' representatives was largely devoted to pointing out contradictory statements and illogical reasoning in the exhibits presented by the unions. The testimony of Frank McManamy was criticized on the ground that he was not a disinterested witness.

J. W. Higgins, testifying in behalf of the western roads, offered as evidence in this case the testimony presented to the board by the Conference Committee of Managers during the course of hearings on national agreements. Mr. Higgins also asked for opportunity to reply to the material contained in the employees' exhibit on piece-work, and this request was granted. Dr. C. P. Neill, representing the southeastern roads, made a similar presentation.

The hearings were closed with a statement by B. M. Jewell on behalf of the employees in which he summed up the employees' objections to the re-establishment of piece-work.

Orders have been issued by the Bureau of Valuation of the Interstate Commerce Commission closing the five district offices and consolidating all work in Washington. H. M. Jones, member of the Engineering Board, with headquarters at Chattanooga, has been appointed supervising engineer and T. P. Artaud, supervisor of land appraisals at Washington, has been appointed executive assistant. It is expected that staff positions in district offices will be abolished as the offices are closed.

Fuel Conditions on the French Railways*

Use of Mixtures and Briquettes; Trend of Locomotive Development; Training of Crews

BY M. DE BOYSSON,

Chief of Locomotive Service, Paris-Orleans Railway, Paris, France

THE average price of French coal and imported coal was, in 1920, more than 250 francs ($50) per ton. The amount of ash, which in ordinary times averaged from 8 to 10 per cent, rose to an average of nearly 17 per cent. At the present time the French railways are paying about fifteen times the pre-war cost for fuel and the total fuel bill now amounts to about 35 or 40 per cent of the total operating expenses as compared to about 16 per cent before the war.

Unfortunately, in spite of the increase in price, it has not been possible to accomplish much in the direction of economy. The reason for this is due to the scarcity of coal, the difficulty of obtaining sufficient supplies of all kinds to provide the proper mixtures, and the fact that a large number of inexperienced men have had to be employed to replace the men lost in the war.

Choice of Fuel

The destruction of the mines in the North and the Pas de Calais districts, greatly reducing the coal resources of France, no longer permitted the railways to choose the fuel best suited for locomotive use and they have had to be satisfied with what they were able to obtain. The situation has, however, improved a little during the past few months and the railways are gradually returning to more economical methods.

The French mines from which the railways draw their supplies produce a fairly large proportion of small coal and, further, screened coal coming from abroad arrives with a large amount of coal dust caused by repeated handling. It is necessary to find a use for this small coal and dust, of which there is too large a quantity to be burned as it stands. Briquetting solves the problem and at the same time increases the supply of select coal, which is not obtained in sufficient quantities from the screened coal to meet the needs of the country. Briquettes are made by mixing 92 parts, by weight, of coal with 8 parts of resin. This mixture forms a briquette of good quality which can be used under the same conditions as the best coal, both under difficult operating conditions and for firing up. The total cost of this briquetted coal is practically the same as that of screened coal and the briquettes have the advantage in that they can be handled and stored in the open with much less deterioration than the screened coal. The weight of the briquettes varies from 6 to 20 lb.

It is the practice of the French railways to mix different grades of fuel in order to obtain the most economical combination for the locomotive service involved. These mixtures will contain more or less high grade fuel according as the service is more or less difficult.

Fuel Stocks and Methods of Handling Coal

In order to obtain the proper mixtures it is necessary to have at each coaling station a fairly large stock of fuel, because regular deliveries of the different grades of fuel cannot be depended on. A large stock is still more important in districts which are supplied with imported fuel. The normal stock allowed for the railways was about three to four weeks' supply for pit coal and six weeks' to two months' for briquettes. The latter should not be used until they are dry, which takes about a month after they are manufactured.

The coal coming from the ports is either mixed immediately when it arrives at the coaling stations, or is placed in separate piles, if the arrivals are too irregular, and mixed in the desired proportions when it is loaded onto the locomotive.

In order to facilitate making these mixtures, mechanical methods of handling have been devised which have the added advantage of reducing the cost of handling.

The coal cars at the coaling stations are unloaded by steam or electric traveling cranes. At engine houses of medium size the locomotive tender is loaded with the same apparatus that is used for unloading the coal as it arrived from the source of supply. In the larger engine terminals, however, the two operations are distinct, principally because the lack of space required that the storage ground for the fuel be placed at a considerable distance from the engine houses. When the locomotive tender is not loaded directly by means of cranes, one of the following two methods is adopted: (a) the coal is placed in small push cars, holding about 3,000 lb., and pulled up an inclined trestle by an electric hoist, where the coal is dumped directly onto the locomotive; (b) the coal is raised, either by a crane or chain buckets, into a regular coal chute from which it is delivered directly to the locomotive.

Purchase and Inspection

On account of the various qualities and sources of supply of the coal used, it is not possible to rely upon the analyses at the mines. The contracts are therefore made for each different grade of coal, fixing the maximum amount of ash and also quantity of water in washed coal at the point at which the fuel is received. Fines or premiums are provided for coal whose maximum is above or below these figures. In the case of briquettes there is an additional cohesion test.

The ordering, inspection and handling of fuel is under the control of a special department, which may or may not be under the jurisdiction of the general supply department of the railways.

Locomotive Improvements for Economical Operation

The use of brick arches, while at the same time protecting the tube plate, has reduced the fuel consumption by 3 or 4 per cent. At the present time all the French locomotives are equipped with them.

The dumping grate and the shaking grate, while not reducing the fuel consumption, have allowed the use of inferior fuel. The dumping grate is used on all engines and the shaking grate on most of the modern engines.

The use of a circular exhaust nozzle, with a variable opening, gives the maximum draft with the least back pressure. Great progress has already been made in the study of the best arrangement for exhaust nozzles; new ones are still being tried.

Boiler lagging is not in general use as the cost of upkeep seems to equal the saving made on the fuel. However, new trials are being made taking into account the present price of coal.

Compounding has realized an economy of 10 per cent compared with the ordinary engines. At first compounding was applied to two-cylinder locomotives, but they have been almost entirely given up on account of the unequal balance

*Abstract of a paper presented before the 1921 convention of International Railway Fuel Association.

caused by this arrangement. All the recent compound engines have four cylinders.

The use of the superheater overcomes the necessity of increasing the steam pressure as required for corresponding and gives, in the case of powerful engines, a saving of about 12 per cent on single expansion engines and 8 per cent on compound engines of the same type. In spite of the economic advantage of compound engines with a superheater and four cylinders, the tendency at present is to return, at any rate as regards engines of average power, to simple engines with a superheater and two cylinders on account of a considerable saving in maintenance and the increased facility of operation.

Feed water heaters using exhaust steam were tried before the war. More than one hundred engines are already fitted with this apparatus. These feed water heaters achieve a certain saving of fuel, but on the other hand there are maintenance difficulties and the question is deserving of thorough study.

Mention should also be made regarding the development of washing and filling boilers while they are hot. Instituted at first in order to diminish the stress of metal in the boilers and to allow the engines to be used again sooner, this process also allows, in certain cases, the recovery of the heat contained in the water of the boilers which are emptied. However, this recovery required extensive apparatus which it was out of the question to install during the war. The present prices are too high for the expected saving to compensate to a sufficient degree for the cost of the apparatus.

Mechanical stokers have not yet been applied to French locomotives. The limitation of the weight per axle (18 tons) does not allow of boilers powerful enough to make these stokers indispensable. Neither has any use been made of pulverized coal, but the railways are following with close attention what is being done abroad and the trials undertaken in France, in order to be able eventually to adopt the practice more or less extensively.

Training of the Engine Crew and Supervision

The hiring and training of locomotive engineers and firemen have always been closely watched by the railways. The employees start as workmen or laborers in the engine houses. After a theoretical and practical examination they can, after a certain time, be employed as extra firemen according to the requirements of the service; but they are not called firemen for a considerable time, which, before the war, was not less than three or four years. After acting for some time as firemen, depending on the aptitude of the employee, they have to undergo a more complete theoretical and practical examination to prove their fitness for the duties of locomotive engineer. Before the war a man was not made an engineer, except in special cases of those who had a more complete training, in less than seven or eight years, of which three years were served as fireman.

During the whole training period the employees are carefully supervised and placed under locomotive engineers who are particularly qualified to act as instructors. During their work the engineers and firemen are frequently accompanied by traveling engineers, who complete their instruction.

The necessity for increasing the strength of the staff very quickly on account of the requirements arising from the war and especially on account of the application of the eight-hour day, forced the railways to train the engine crews very hurriedly and to reduce the length of the term of probation, certainly to the detriment of the skill of the employees and the fuel consumption.

It is not enough to train the engine crews; they must also be interested in producing results. To accomplish this the railways give the engineers and firemen a share in the fuel savings. A certain quantity of coal is allotted to each service, based either on train-miles or ton-miles and the saving made on the allotment is paid to the men at a contract price. The results obtained from this premium were very satisfactory. Recently, owing to pressure from the unions, a guaranteed minimum of premium has had to be assured to the men each month, whatever the amount of the premium actually realized, and many of them have been content to draw this minimum without trying to obtain greater savings.

The maintenance of the locomotives is also closely watched. Strict rules as to the periodical inspection of the engines are in force at the engine houses and supplementary inspections must also be made whenever it is necessary to maintain the engines in good condition. Provision is made in particular for the piston rings to be replaced about every 20,000 miles; but the rings are replaced before this when the wear exceeds a certain amount. The cylinders are rebored when the difference between two perpendicular diameters reaches 1.5 m.m. (.06 in.). A sharp lookout is kept in this respect at the main shops.

Assigned Locomotives

In general, each engine is assigned to an engineer who alone is to use it. This arrangement gives excellent results as regards economy in fuel consumption. Moreover, in this way more delicate and more economical machinery can be used, because it can be kept in better order. Naturally, this method requires a large number of engines. However, the difference is not so great as might be supposed at first sight, for the better care the engines receive greatly reduces the number of engines held out of service for incidental repairs. From the attempts made by the railways to pool the engines on account of the lack of engines during the war and at the time of the application of the eight-hour day, together with the observations made on the results obtained in the transport service by the American forces in France during the war, we have been able to draw the conclusion that, even in the case of two-cylinder single expansion engines the number of locomotives required for the assigned service, only slightly exceeds—less than 10 per cent—that required in the pooled service. With the more complicated compound engines, the maintenance of which requires more attention, the difference would be still less and, perhaps, even to the advantage of the assigned system.

As this latter system is much superior as regards fuel consumption and cost of maintenance, the French railways continue to use it even though the eight-hour day has increased the number of engine terminals and the number of engines themselves.

Conclusions

The efforts which the railways made to reduce fuel consumption had produced very considerable results before the war. In both passenger and freight service the fuel consumption per gross ton-mile hauled, had diminished by more than 10 per cent between the years 1900 and 1913, in spite of an appreciable increase in speeds. Unfortunately, the disorganization occasioned by the war has caused the greater part of the progress made to be lost.

Experiments have been made for replacing coal with liquid fuel and also by the development of electric traction. Several engines have been equipped to burn oil, using the oil burning arrangements adopted in the United States. Up till now the results appear satisfactory from an operating point of view, but France does not possess any oil and has to import it. The problems of the cost of this fuel and certainty of supplies are still far from being solved.

On the other hand, the development of electric traction with hydro-electric power stations—there is abundant water power available in France—is certain. The three railways which are in mountainous districts, the Paris-Lyon-Mediterranean, the Paris-Orleans, and the Midi, have drawn up programs including, from now onward, the electrification of a large portion of their lines. Surveys are being made, a large part of the concessions granted, and the work will commence

shortly. Nevertheless, it will still be some years, especially with the present delays in construction, before an appreciable saving in coal is reached. It will be possible to make a saving of 3,000,000 tons of coal per year when the whole program is completed.

Even for parts where steam-driven electrical power stations have to be used, the substitution of electrical power for steam locomotives ought to bring about a saving in coal of about 50 per cent.

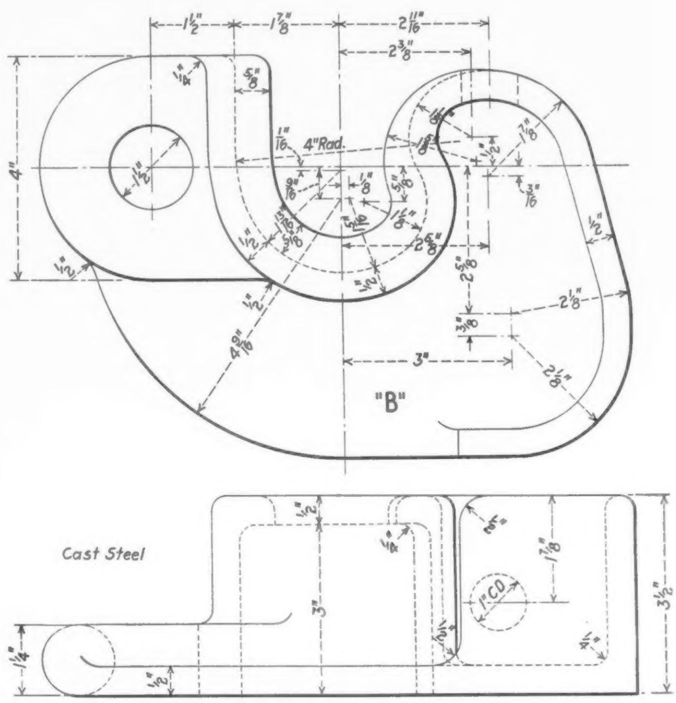
Mix Thermit Thoroughly Before Using

Occasionally Thermit welders find that they are unable to produce the requisite amount of steel from the Thermit which they are using. This is entirely due to the fact that the ingredients (iron oxide and aluminum) have become unmixed. The importance of mixing Thermit thoroughly before using cannot be too strongly emphasized, whether a whole bag or part of a bag is to be used. It is logical that, as the iron oxide is in the form of a flake and the aluminum is in the form of a little round ball, also that as they are so different in specific gravity, they will segregate in the vibration caused by transit. The bag, therefore, should be dumped and the material thoroughly mixed by hand before putting it into the crucible. In a recent case, the Metal & Thermit Corporation, New York investigated the variations in the speed with which Thermit reactions took place. This variation was found to be entirely due to segregation of materials and was entirely eliminated by re-mixing.

An Auxiliary Car Coupler

BY NORMAN McCLEOD

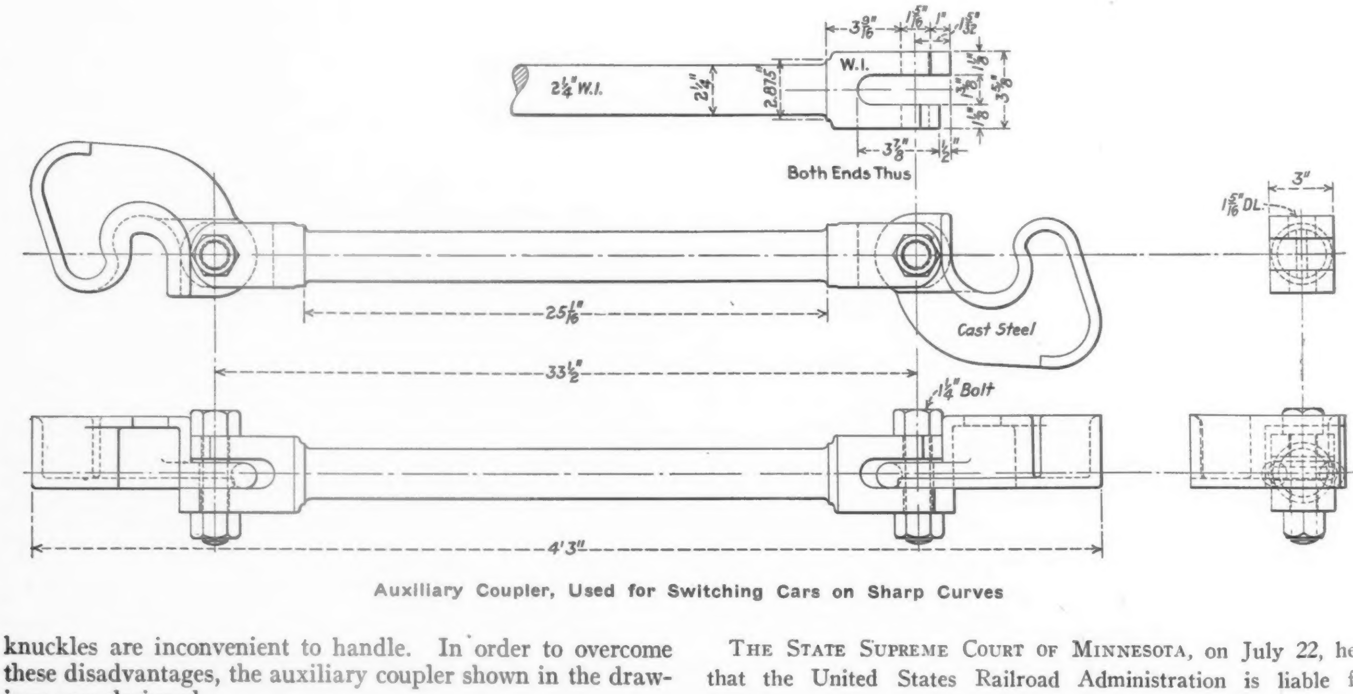
In placing cars on tracks leading into industrial plants in cities, considerable difficulty is often experienced because some of the curves are so sharp that the ordinary couplers do not have sufficient clearance to make the sharp turns without fouling. Handling cars with a link between the knuckle pins is not satisfactory and the majority of emergency switching. They are made to fit the contour of the standard coupler as shown in the detailed drawing of the head. It will be noted that a flange is provided at the top of the casting. This prevents the head from slipping down through the coupler with which it is engaged and holds it in the proper position while switching. The rod connecting the heads is



Detail of the Coupler Head

made of a 2¼ in. wrought iron bar with a clevis on each end.

This device is very useful for placing single cars on sharp curves. It is not intended for handling long cuts, although several cars can be switched with the coupler if occasion requires.

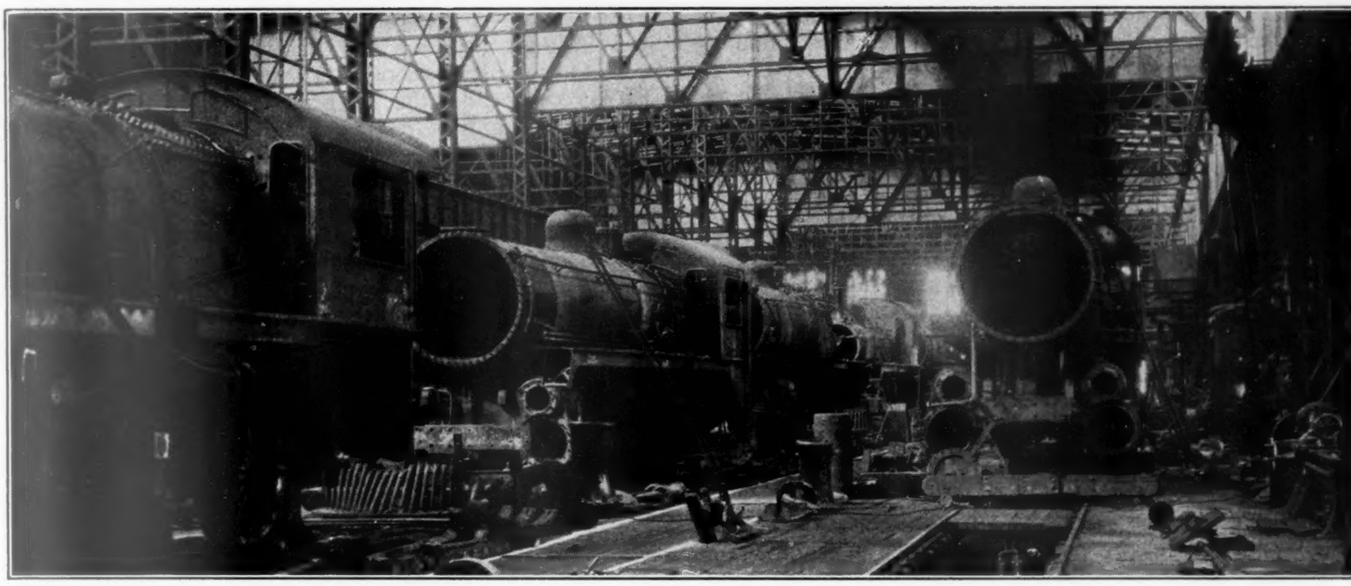


Auxiliary Coupler, Used for Switching Cars on Sharp Curves

knuckles are inconvenient to handle. In order to overcome these disadvantages, the auxiliary coupler shown in the drawings was designed.

The heads at each end are steel castings, light in section, yet strong enough to stand the stresses imposed upon them in

The State Supreme Court of Minnesota, on July 22, held that the United States Railroad Administration is liable for damages resulting from a fire which started on the Great Northern tracks near Cloquet, Minn., and swept into that city in October, 1918, causing a loss of many hundred thousand dollars.



Erecting Shop of Canadian Pacific, Angus, Montreal

No Meeting of Mechanical Division This Year

Reports of Eight Committees Submitted to Letter Ballot of the Members by General Committee

The indefinite postponement of the business meeting of Mechanical Division, American Railway Association, to have been held at the Blackstone Hotel, Chicago, June 29 and 30, has been made permanent for this year. This action was taken after the adoption of the following resolution by the Association of Railway Executives at a meeting held at New York on July 1, 1921:

"*Whereas,* in view of the imperative need for the exercise of all possible economy, it is

"*Resolved* that annual or special meetings or conventions of all organizations under the supervision of this body be indefinitely postponed or curtailed in every possible way."

Following the decision of the General Committee of the Mechanical Division not to hold a meeting of the division this year it was decided to submit to a letter ballot of the members the recommendations of the various committees, the reports of which were to have been presented at the meeting of the division. The letter ballot will close at noon, central time, on Tuesday, September 20.

Abstracts of the reports follow.

Specifications and Tests for Materials

Sub-committees have been appointed and are now actively engaged in work on the subjects assigned.

(*a*) Co-operation with the Rubber Association of America on the preparation of Specifications for Mechanical Rubber Goods.

(*b*) Co-operation with the Equipment Painting Section in the preparation of specifications for paint and painting materials.

(*c*) Specifications for welding wire.

(*d*) Specifications for water gage and lubricator glasses.

(*e*) Revision of present specifications for galvanized sheets.

In addition to the above the chairman has had some correspondence with the chairman of the Train Brake and Signal Committee on the subject of tolerances for air brake and signal hose gaskets and gages for gaskets and couplings, with a view to improving present practice in these particulars. Further work should be done on these subjects during the coming year.

Subjects Referred to the Committee By the General Committee

(*a*) "The proper fibre stress to be employed in the design of helical springs of different diameters of steel wire from ½ in. to 1½ in. in diameter. The original spring table calls for 80,000 lb. per square inch throughout for all sizes, but it is well known that this is not the manufacturers' practice, and, in fact, in many cases it is impossible to obtain a proper spring with the smaller sizes of wire."

A sub-committee was appointed to report on this question, and after investigating the available data on spring design and manufacture, has reported that in its opinion tests should be made to develop information on various grades of steel and different heat treatments. It has not been practicable for your committee to arrange for such tests, nor does it seem at all feasible to make any such arrangements under the present conditions or in the near future. The number of variables affecting spring design, in addition to that of variation in diameter of wire, such as quality of steel, workmanship and heat treatment, makes the whole subject a very indefinite one and one that would require long and expensive investigation, probably without satisfactory results.

The committee will keep this matter before it and will take such action as may be possible.

(*b*) "Heat Treated Axles and Crank Pins. Has the process of heat treatment decreased the number of failures to any appreciable extent?"

The committee feels that it does not have sufficient in-

formation to reply to this question, and is endeavoring to obtain the views of other members of the Association by means of a questionnaire.

(c) "Revision of Specifications for Lumber, if such revision is needed. Representatives of the Purchases and Stores Division to be requested to co-operate with the Committee on Specifications and Tests."

No action has been taken on this subject. The committee desires the benefit of advice from all interested members on: (1) What use, if any, is being made of the present Lumber Specifications? and (2) Suggestions for revising the specifications so that they might be of greater use.

Co-operation with the Car Construction Committee

In its report to the Association in June, 1920, the Car Construction Committee made certain recommendations regarding the desired quality of steel for forgings and castings for railroad use, and gave an outline of what, in its opinion, constituted certain fundamental requisites for specifications. Chief among these was the requirements of the elastic limit as a base determination and specifying the elongation in 2 in. and the reduction of area to be controlled by the elastic limit and given constants. Other requirements covered chemical composition and annealing and the recommended constants for tensile properties of two grades of steel with 26,000 and 32,000 lb. per sq. in. elastic limits, respectively.

The committee has spent most of its time at recent meetings in the endeavor to satisfactorily carry out these recommendations of the Car Construction Committee, which have been approved by the Association, and regrets that it has not been entirely successful, partly because of the large amount of work involved in revising the specifications, and partly because of differences of opinion that have arisen between members of our committee and representatives of the Car Construction Committee as to the practicability of certain of the latter's recommendations.

The question of standardizing methods of tests so that results obtained in different laboratories will be comparable is one that is engaging the attention of your committee at this time, and will require its best efforts for some time to come, and also the assistance of all members with laboratories who may be willing to help with the work.

Supplementary Report—Specifications for Chrome Molybdenum Steel Springs

The unsatisfactory condition of Class D bolster springs for trucks of 100,000 lb. capacity cars has been brought to the attention of the Committee on Car Construction, which has prepared designs for alternate springs *L*, *M*, *N* and *O*, to be substituted for present standard springs, classes *B*, *C*, *D* and *H*. The Committee on Car Construction has requested that this committee prepare specifications covering their alternate special springs.

The committee has prepared tentative specifications for chrome molybdenum steel springs, as requested. The committee has not been able to develop any satisfactory information regarding what service may be expected from springs made of chrome molybdenum steel but agrees with the Committee on Car Construction that such springs should be made and tested out in service in order to develop whether they are an improvement over the present carbon steel springs, which have been found to give very unsatisfactory service.

Recommendations

Tentative Specifications

As a result of conferences with representatives of the Car Construction Committee, your committee offers the following specifications and recommendations:

Exhibit A.—A revision of the Standard Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks.

Exhibit B.—A revision of the present Specifications for Steel Castings for Cars and Locomotives, combining these two into one specification.

It is recommended that the present Specifications for Axles and Steel Castings be retained without change and that both of the above proposed specifications be printed in the proceedings as tentative specifications until further action is justified by the experience of the members in working to them. Your committee feels that this action is warranted by the newness of the proposed method of expressing physical properties, as shown in the Steel Casting Specifications, and the many changes that have been made in the Axle Specifications, as well as by the necessity of having both the consumers and manufacturers become thoroughly familiar with these specifications before they are made obligatory.

Supplementary Report, Exhibit D.—The committee recommends that this specification for Chrome Molybdenum Alloy Steel Helical Springs be adopted as tentative for one year or until further action is recommended by the committee.

Changes in Standard Specifications

Exhibit C.—Standard Specifications for Heat Treated Knuckle Pivot Pins to be revised as shown. This increase in the range of both carbon and manganese is recommended to cover the usual grade of steel used for this purpose, as it has been found by experience that the present limits are unnecessarily close.

Recommended Practice Specifications

The committee does not recommend advancing any of the present Recommended Practice specifications to Standard, for the reason that some changes may have to be made in a number of these if the proposed changes in the method of expressing tensile test requirements develop satisfactorily.

Limiting the Revision of Specifications

The frequent revision of specifications has been severely criticized by both purchasers and manufacturers, and is clearly an undesirable state of affairs. Therefore, it is recommended that the Association should give serious consideration to establishing a definite time limit for revisions of specifications and other standards which will appear in the Manual, this limit to be preferably three years, during which no changes should be allowed except for reasons important to the interest of the Association and then only if the proposed changes receive at least two-thirds vote at the annual meeting of the Division.

The report is signed by F. M. Waring (chairman), Pennsylvania System; J. R. Onderdonk, Baltimore & Ohio; Frank Zeleny, Chicago, Burlington & Quincy; A. H. Fetters, Union Pacific; H. G. Burnham, Northern Pacific; H. E. Smith, New York Central; J. C. Ramage, Southern Railway; J. H. Gibboney, Norfolk & Western; H. P. Hass, New York, New Haven & Hartford, and G. M. Davidson, Chicago & North Western.

Exhibit A—Proposed Tentative Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks

1. *Scope.*—Same as Standard Specifications except that paragraph (b), requiring annealing of all axles over 6 in. in diameter at the center, has been omitted.

I—Manufacture

2. *Process*—(a) Steel shall be made by the open hearth or electric process.

(b) All axles over 6 in. in diameter at the center *and axles with* 0.52 *per cent or more carbon* shall be annealed by allowing the finished forgings to become cold after forging, then uniformly reheating to the proper temperature to refine the grain and allowing to cool uniformly.

II—Chemical Properties and Tests

3. *Chemical Composition*—The steel shall conform to the following requirements as to chemical composition:

	Per cent
Carbon, maximum	0.58
Phosphorus, not over	0.05
Sulphur, not over	0.05

4. *Ladle Analyses*—Same as Standard Specifications.
5. *Check Analyses*—Same as Standard Specifications.

III—PHYSICAL PROPERTIES AND TESTS

6. *Drop Tests*—(a) Same as Standard Specifications.

(b) The permanent set produced by the first blow shall not exceed that given by the following formula, in which L = length of axle in inches and d = diameter of axle at center in inches.

$$\frac{L}{1.9d} - \frac{d}{2} + \frac{1}{2} \text{ in.}$$

(c) The requirements for five standard sizes of axles based on the above formula are given in the following table:

Classification of axle	Size of journal, in.	Diameter of axle at centre, in.	Length of axle, in.	Height of drop, ft.	Number of blows	Maximum permanent set, in.
A	3¾ by 7	4¼	83¼	18	5	8¾
B	4¼ by 8	4¾	84¼	22½	5	7½
C	5 by 9	5⅜	86½	29	5	6¼
D	5½ by 10	5⅞	88½	34½	5	5½
E	6 by 11	6 7/16	90¼	41½	5	4¾

(d) Same as Standard Specifications.

(e) Same as Standard Specifications.

7. *Drop-test Machine*—Same as Standard Specifications.
8. *Number of Tests*—Same as Standard Specifications.

IV—WORKMANSHIP AND FINISH

9. *Workmanship*—(a) and (b) Same as Standard Specifications.
10. *Finish*—Same as Standard Specifications.

V—PERMISSIBLE VARIATIONS AND WEIGHTS

11. *Permissible Variation*—Same as Standard Specifications.

VI—MARKING AND STORING

12. *Marking*—Same as Standard Specifications.
13. *Storing*—Same as Standard Specifications.

VII—INSPECTION AND REJECTION

14. *Inspection*—(a), (b) and (c) Same as Standard Specifications.
15. *Rejection*—Same as Standard Specifications.
16. *Rehearing*—Samples tested in accordance with Section 5, which represent rejected material, shall be preserved fourteen days from date of test report. *In case of dissatisfaction with results of test, the manufacturer may make claim for a rehearing within that time.*

Exhibit B—Proposed Tentative Specifications For Carbon Steel Castings

1. *Scope*—(a) These specifications cover annealed and unannealed carbon steel castings for locomotive and car equipment, and for miscellaneous use.

(b) The purposes for which the two grades are generally used are:

Grade A, for castings designed for a low stress.

Grade B, for castings designed for unit stresses of 12,500 to 16,000 lb. per square inch such as truck side frames, bolsters, couplers and coupler parts, locomotive frames, locomotive driving and trailer wheel centers.

I—MANUFACTURE

2. *Process*—The steel may be made by the open-hearth *or any other process approved by the purchaser.*

3. *Annealing*—(a) Grade A steel shall be annealed if the carbon content exceeds 0.30 per cent, or if the manganese content exceeds 0.75 per cent. Grade B steel shall be annealed if the carbon content exceeds 0.22 per cent, or if the manganese content exceeds 0.65 per cent.

(b) Castings of both Grades "A" and "B" of irregular section, and of less carbon or manganese content than specified in paragraph (a), where shrinkage or other internal stresses may be expected, should be annealed.

(c) Castings that require annealing shall be allowed to become cold. They shall then be uniformly heated to the proper temperature to refine the grain and allowed to cool uniformly.

(d) Annealing Lugs.—For the purpose of determining the quality of annealing, at least two and not more than four annealing lugs shall be cast on all castings 150 lb. and over, and on such castings less than 150 lb. as required by the purchaser. The locating of the annealing lugs shall be agreed upon by the inspector and the manufacturer. The standard annealing lug shall be 1 in. in height and 1 in. in width and ⅝ in. in thickness where it joins the casting. The inspector may remove one-half and the manufacturer one-half of the number of annealing lugs.

(e) If, in the opinion of the purchaser or his representative, a casting is not properly annealed, he may at his option require the casting to be reannealed.

II—CHEMICAL PROPERTIES AND TESTS

4. *Chemical Composition*—The steel shall conform to the following requirements as to chemical composition:

Phosphorus, not over	0.05 per cent
Sulphur, not over	0.05 per cent

5. *Ladle Analyses*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, *silicon*, phosphorus and sulphur. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, when requested, and shall conform to the requirements specified in Section 4.

6. *Check Analyses*—A check analysis may be made by the purchaser from the broken tension test specimen or from a casting representing each melt. The *phosphorus and sulphur* thus determined shall conform to the requirements specified in Section 4. *Determination of carbon and manganese should be made as information to ascertain whether the annealing was in accordance with Section 3 (a).* Drillings for the analysis shall be taken not less than ¼ in. beneath the surface, *and if from a casting shall be taken in such a manner as not to impair its usefulness.*

III—PHYSICAL PROPERTIES AND TESTS

7. *Tension Tests*—(a) The steel shall conform to the following minimum requirements as to tensile properties:

	Grade A	Grade B
Elastic limit, lb. per sq. in.	26,000	32,000
Yield point, lb. per sq. in.	29,250	36,000
Product of elastic limit and per cent elongation in 2 in.	700,000 (not less than 22%)	850,000 (not less than 18%)
Product of yield point and per cent elongation in 2 in.	788,000 (not less than 22%)	956,000 (not less than 18%)
Product of elastic limit and per cent reduction of area	975,000 (not less than 33%)	1,200,000 (not less than 27%)
Product of yield point and per cent reduction of area	1,100,000 (not less than 33%)	1,350,000 (not less than 27%)

(b) The ultimate tensile strength shall be reported as information.

(c) Either the elastic limit or the yield point, but not both, shall be determined. The elastic limit called for by these specifications shall be determined by an extensometer reading to at least 0.0002 in. The extensometer shall be attached to the specimen at the gage marks and not to the shoulders of the specimen nor to any part of the testing machine. When the specimen is in place and the extensometer attached, the testing machine shall be operated so as to increase the load on the specimen at a uniform rate. The observer shall watch the elongation of the specimen as shown by the extensometer and shall note for this determination the load at which the rate of elongation shows a sudden increase. The extensometer shall then be removed from the specimen, and the test continued to determine the tensile strength.

(d) The yield point, or the elastic limit, shall be determined at a crosshead speed not to exceed ⅛ in. per minute and tensile strength at a speed not to exceed 1½ in. per minute. The yield point shall be determined by the drop of the beam of the testing machine.

8. *Alternative Tests to Destruction*—In the case of orders including only castings not exceeding 150 lb. in weight, a test to destruction on one casting for each 100 castings or smaller lot may, *at the option of the purchaser,* be substituted for the tension tests. This test shall show the material to be ductile, free from injurious defects, and suitable for the purpose intended. *Castings of minor importance may be accepted on surface inspection.*

9. *Test Specimens*—(a) Same as both Standard Specifications.

(b) An adequate number of test coupons shall be cast with and attached to castings weighing over 150 lb. from each melt when presented for inspection; coupons shall be cast attached to each end of each locomotive frame, to each locomotive cylinder and to each wheel center. If the design of the casting is such that the test coupons cannot be attached, the test bars shall be cast in runners outside of the casting, but attached to it to represent each melt. The location of the test coupons or bars, as well as the method of casting such coupons or bars, shall be subject to mutual agreement by the inspector and manufacturer. In the case of any orders for castings weighing under 150 lb., the physical properties as required in Section 7 may be determined from an extra or spare test bar cast with and attached to some other casting from the same melt.

(c) When sufficient coupons have not been cast, a test specimen

may be cut from a finished casting at a location mutually agreed upon by the inspector and manufacturer.

10. *Grouping Melts*—(a) After 15 consecutive melts, which may contain any of all *kinds* of castings (*except frames, wheels centers and cylinders*) covered by these specifications on one or more orders, have been tested and accepted, the manufacturer may group the succeeding melts in lots of five melts each, but each lot not to exceed 40 tons; the entire group to be accepted if the test specimen selected from the lot fulfills the chemical and physical requirements herein specified. If this test fails, a rehearing will be granted on the melt that the failed bar represents, and the other four melts of the group shall be tested individually.

(b), (c) and (d) Same as in Standard Specification for Car Castings.

11. *Number of Tests*—(a) One tension test shall be made from each locomotive frame. One tension test may be made from each wheel center and each locomotive cylinder casting, but at least one of each kind of such castings in each melt shall be tested. For miscellaneous castings from melts which do not include frames, wheel centers or cylinders, one tension test shall be made from each melt except as provided in Section 10 (a).

(b) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 7 (a) and any part of the fracture is more than ¾ in. from the center of the gage length as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

(d) If the results of physical tests do not conform to the requirements specified, the manufacturer may reanneal the castings but not more than twice. A retest shall be made as specified in Section 7.

(e) No part of these specifications shall operate to cause any one tension to apply to more than 40 tons of castings that are offered for inspection.

IV—WORKMANSHIP AND FINISH

12. *Workmanship*—Same as both Standard Specifications.

13. *Finish*—(a) and (b) Same as both Standard Specifications.

V—MARKING

14. *Marking*—The manufacturer's name or identification mark and the specified pattern number shall be cast on all castings. In addition, the month and the year when made shall be cast on all bolsters, truck sides and similar castings. The location and size of numbers shall be agreed upon by the manufacturer and the inspector. In accordance with the standard practice of the individual foundry, to identify individual castings, a serial number may be cast or the melt number may be stamped on bolsters, truck side and similar castings as agreed upon by the manufacturer and the inspector. The melt number shall be legibly stamped on all other castings weighing over 150 lb.

VI—INSPECTION AND REJECTION

15. *Inspection*—Same as both Standard Specifications.

16. *Rejection*—(a). and (b) Same as both Standard Specifications.

17. *Rehearing*—Samples tested in accordance with Section 6, which represent rejected castings, shall be preserved for two weeks from the date of test report. *In case of dissatisfaction with the results of tests, the manufacturer may make claim for rehearing within that time.*

Exhibit C

It is recommended that the following changes be made in Section 3 of Standard Specifications of Heat Treated Knuckle Pivot Pins.

3. *Chemical Composition*—The steel shall conform to the following requirements as to chemical composition:

	Present Per cent	Proposed change Per cent
Carbon	0.55-0.70	0.55-0.75
Manganese, not over	0.60	0.70
Phosphorus, not over	0.05	0.05
Sulphur, not over	0.05	0.05

Exhibit D—Proposed Tentative Specifications for Chrome Molybdenum Alloy Steel Helical Springs

(Classes L, M, N and O, to be substituted for present standard classes B, C, D and H.)

I—MANUFACTURE

1. *Process*—The steel may be made by the open-hearth, crucible or electric furnace process.

II—CHEMICAL PROPERTIES AND TESTS

2. *Chemical Composition*—The steel shall conform to the following requirements as to chemical composition:

Carbon, per cent	.40— .50
Manganese, per cent	.40— .60
Chromium, per cent	.80—1.10
Molybdenum, per cent	.30— .50
Phosphorus, maximum, per cent	.04
Sulphur, maximum, per cent	.045
Silicon, maximum, per cent	.25

3. *Check Analyses*—An analysis may be made by the purchaser from a sample representing each 20,000 lb., or fraction thereof, of each size of spring steel involved. The chemical composition thus determined shall conform to the requirements specified in Section 2.

4. *Sample for Analysis*—(a) If the section is large, a specimen weighing about ½ lb. shall be cut from any part of the spring, or if the spring is small, the entire spring may be taken. If the sample is cut off hot, it shall be cooled in such a way as not to harden it. The inspector shall stamp the sample with his private mark as soon as it is cut off.

(b) The drillings for check analysis shall be made from the sample so selected; the drill to be approximately one-half the diameter of the wire. The drillings shall be mixed from the total drillings obtained by passing entirely through the section of the wire.

III—PHYSICAL PROPERTIES AND TESTS

5. *Physical Tests*—(a) The properties specified in paragraphs (b), (c), (d) and (e), shall be determined in the order specified. The spring shall not be rapped or otherwise disturbed during the test.

(b) *Solid Height*—The solid height is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load of at least one and one-quarter times that necessary to bring all coils in contact. The solid height shall not exceed that specified by more than 1/16 in.

(c) *Free Height*—The free height is the height of the spring when the load specified in paragraph (b) has been released, and is determined by placing a straight-edge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straight-edge at the approximate center of the spring. The free height shall not exceed that specified by more than ⅛ in.

(d) *Loaded Height*—The loaded height is the difference between the plates of the testing machine when the specified working load is applied. The loaded height shall not vary more than 1/32 in. under that specified.

(e) *Permanent Set*—(1) The permanent set is the difference, if any, between the free height and the height after the spring has been compressed solid three times in rapid succession, with the test load specified in paragraph (b), measured at the same point and in the same manner. The permanent set shall not exceed 1/32 in.

(2) If there is any permanent set not exceeding 1/32 in. the difference between the free height and the height after the test load of 1½ times the specified working load has been applied and fully released two additional times, shall not be greater than the permanent set first measured.

6. *Number of Tests*—(a) A lot for physical test shall consist of not more than 500 individual coils, regardless of the grouping.

(b) From each lot of springs which has met the requirements of Sections 8 and 9, the purchaser or his representative may select for physical test at least 10 per cent, to be tested in accordance with the requirements of Section 5.

7. *Retests*—If any of the springs representing a lot fail to meet the requirements as to physical properties specified in Section 5, but at least one-half of the springs representing a lot do meet these requirements, each spring of the lot shall be tested, and those which meet the requirements shall be accepted. If more than one-half of the springs representing a lot fail to meet the requirements specified in Section 5, the lot will be rejected.

Footnote—A suggested heat treatment is as follows:

(a) The coiling should be done at temperatures between 1,700 degrees F. and 1,800 degrees F., and the steel shall be cooled slowly in air, not quenched from the coiling heat, until black.

(b) Springs should be reheated after coiling to a temperature of 1,525 degrees F. to 1,575 degrees F., and quenched in oil.

(c) Springs should be removed from the oil when at a temperature of about 300 degrees F. and either allowed to cool slowly in air or immersed immediately in the drawing bath. The springs should be drawn as soon as possible after quenching.

(d) The drawing should be done in a salt bath at a temperature of 940 degrees F. to 960 degrees F., and the springs should be allowed to remain in the bath and at that temperature for at least one hour.

IV—PERMISSIBLE VARIATIONS

8. *Bars*—The gage of the bars shall be within the limits as specified in A. R. A. Specifications for Carbon Steel Bars for Railway Springs.

9. *Springs*—The outside dimensions of the springs, excepting the height, shall not vary more than 1/16 in. from that specified.

V—Workmanship

10. *Workmanship*—(a) The springs shall be of a uniform pitch. The ends shall be tapered to present a flat bearing surface of at least two-thirds the circumference, at right angles to the axis of the springs within a tolerance of ⅛ in, to the foot.

(b) The spring bars shall be free from seams, excessive scale, roll marks or scratches which may constitute injurious defects.

VI—Marking

11. *Marking*—(a) The name or brand of the manufacturer, the year and month of manufacture and, if specified, the purchaser's class number, shall be legibly stamped on each spring at a place not detrimental to the life of the spring.

(b) Any stamping by the inspector shall be so placed as not to be detrimental to the life or service of the spring.

VII—Inspection and Rejection

12. *Inspection*—(a) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the springs ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities and necessary assistance to satisfy him that the springs are being furnished in accordance with these specifications.

(b) The purchaser may make the tests to govern the acceptance or rejection of the material in his own laboratory or elsewhere. Such tests, however, shall be made at the expense of the purchaser.

(c) All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

13. *Rejection*—(a) Material represented by samples which fail to conform to the requirements of these specifications will be rejected.

(b) Individual springs which, subsequent to the above tests at the mills or elsewhere and their acceptance, show defects or imperfection will be rejected and shall be replaced by the manufacturer.

14. *Rehearing*—Samples tested in accordance with Section 3, which represent rejected material, shall be held for two weeks from the date of test report. In case of dissatisfaction with the results of tests, the manufacturer may make claim for a rehearing within that time.

15. *Reworking*—Any springs which fail to meet the requirements of the physical tests or conform to the specified dimensions may be again submitted after being reworked.

Joint Committee on Joint Inspection of Standard Materials

A joint committee, representing the Mechanical and Purchases and Stores Sections, took up the question of co-operative inspection of standard materials at a meeting in Chicago on February 24, at which two methods of handling such a scheme were brought out: First, a regional plan whereby the roads with inspection forces would handle all inspection for other roads in certain regions; second, a central bureau of inspection organized and operated by the American Railway Association but without testing laboratories.

With either plan the roads interested must necessarily agree on uniform material specifications which would naturally be those of the association covering such standard materials as air-brake and signal hose, air coupling gaskets, couplers and coupler parts, axles, springs, wheels, side frames, bolsters, brake beams and journal bearings.

The majority of the committee is of the opinion that the regional plan of inspection by certain roads for others would not work out satisfactorily, primarily because the sources of material are largely confined to a restricted area and the burden would fall upon a comparatively few roads operating in that area. These roads would have to increase their inspection and testing facilities, and, further, such an increase in their work might result in discrimination in favor of their own material under certain conditions of pressure for material.

The central bureau of inspection under the control of the association appears to possess the greatest practical value, provided always that the railroads now purchasing material without inspection can be brought into the organization and made to stand their pro rata share of the expense. The manager of such a bureau should have authority to rule on all disputes between his inspectors and manufacturers, and there should be no appeal from his decision.

The roads now inspecting their own standard parts would have to agree to turn this part of their work over to the central bureau and stand their share of the expense, continuing their own inspection forces on other material. For certain large railroads this would indicate additional expense without benefit, but experience may prove otherwise.

It is recommended that the association sound out its members to ascertain their willingness to co-operate on either of the two plans outlined above.

F. M. Waring was chairman of the committee.

Report of Arbitration Committee

During the year Cases 1167 to 1183, inclusive. have been decided and copies sent to the members. These decisions are made part of this report. A vote of concurrence is requested.

With the approval of the General Committee, this committee has continued the rendering of interpretations of such questions as have been asked by the members regarding the Rules of Interchange. The more important of these interpretations have been issued to the members in Supplement No. 1 to the 1920 Rules of Interchange.

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been carefully considered by the committee and, where approved, changes have been recommended.

RECOMMENDED CHANGES IN THE RULES OF INTERCHANGE

Preface

In order to more clearly indicate the spirit and intent of the Rules of Interchange the committee recommends that the preface to the rules be modified in accordance with the proposed form shown below:

These rules are formulated as a guide to the fair and proper adjustment of all questions arising between car owner and handling company with the intent of:

1. Making car owners responsible for, and therefore, chargeable with the repairs to their cars necessitated by ordinary wear and tear in fair service; by the Safety Requirements and by the Standards of the American Railway Association.

2. Placing responsibility with and providing a means of settlement for damage to any car, occurring through unfair usage or improper protection by the handling company.

3. Providing an equitable basis for charging such repairs and damages.

Inspection of freight cars for interchange and method of loading will be in accordance with this Code of Rules and the Specifications for Tank Cars and Loading Rules issued by this Association.

RULE 2

The committee recommends that the fourth paragraph of Section (b) of this rule be modified in accordance with the proposed form shown below in order more definitely to cover the intent of the requirement:

Cars using lighting outfits operated by *engines using inflammable liquids with flash point* 80° *F. or lower, such as gasoline, motor fuel and alcohol,* will not be accepted in interchange. *This will not apply to lighting outfits operated by petroleum oils with flash point above* 80° *F., such as kerosene or illuminating oil.*

RULE 3

The committee recommends that the second paragraph of Section (h) of this rule be eliminated.

The committee recommends that the effective date of Section (i) be extended to October 1, 1923.

The committee recommends that Section (1) be modified to correspond with the Loading Rules for maximum spacing dimension for side stake pockets on flat cars and that the effective date of this requirement be extended to January 1, 1923, as follows:

All flat cars that can be used for twin or triple shipments of lading, built after January 1, 1918, must have side stake pockets spaced minimum 2 ft. 0 in. and maximum *4 ft.* After *January 1, 1923,* no flat car that can be used for twin or triple shipments will be accepted in interchange unless the side pockets are so spaced.

RULE 9

The committee recommends that the following paragraph be omitted from Rule 9 as this requirement is already provided for in the item of "Air Brakes Cleaned":

When triple valve and cylinder are cleaned, the initial of road and date of last previous cleaning must be shown.

The committee recommends that requirement for showing location be added to item covering metal brake beams R. & R., making this item to read as follows:

Metal brake beams, R. & R...	New or second-hand, applied. If A. R. A., and number of same, or non-A. R. A. Make or name. Cause of removal. *Location number (see Rule 14).*

RULE 14

The committee recommends that the following be added to the second paragraph of this rule:

The same order of numbers shall be used for designating corresponding location of brake beams. In any case where a right or left side is designated on defect, billing repair or joint evidence cards for other parts of cars, the same uniform order of location shall govern.

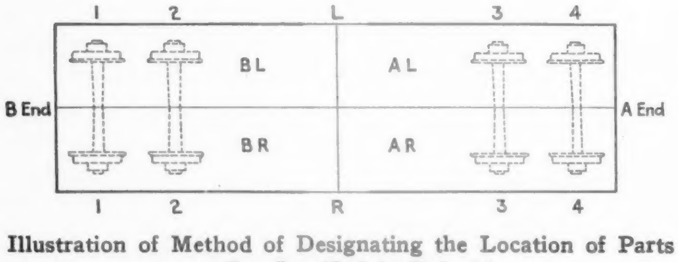


Illustration of Method of Designating the Location of Parts on Car Specified in Rule 14

The committee recommends that the accompanying figure be added to this rule.

RULE 19

The committee recommends that the following paragraph be added to Rule 19:

Plain cast-iron brake shoes should not be used. New reinforced back brake shoes must be used to justify bill.

RULE 22

In order to define the intent of this rule more clearly, the committee recommends that the second paragraph be modified to read as follows:

Longitudinal sills may be spliced at both ends; intermediate or side sills on either side of the body bolster. The nearest part of the splice must not be less than 12 in. from edge of body bolster. Intermediate sills, spliced between body bolster and cross-bearer, must be reinforced as per Figs. 11 or 11-A. Intermediate sills, spliced between bolster and end of car, and side sill, spliced on either side of bolster, must be in accordance with Figs. 10 or 10-A, preferably the latter.

RULE 23

It is evident from the questions referred to the committee that Section IV of this rule is more or less confused. In order to clarify the intent of this rule, the committee recommends that Section IV be modified in accordance with the proposed form shown below:

Welding cracks or fractures will be permitted on the following:
Car and roof sheets.
*Cast steel truck sides.
*Pressed and structural steel truck sides, bolsters and transoms.
*Cast steel bolsters.
Draft castings.
*Brake beams.
*Cast steel coupler yokes.
Car sills, posts, braces, stakes, carlines, side plates and end plates.

Other car parts subject to compression only, and those not subject to high tension strains, except as otherwise prohibited.

*Welding is permitted only when the area of the crack is less than two-fifths, or 40 per cent, of the total area through the section at the point of fracture, but it is not permissible to weld any crack located within 6 in. of an old weld.

RULE 49 (Owners Responsible)

The committee recommends that Rule 49 be modified to read in accordance with the proposed form shown below:

(1) *All steel cars not equipped with cardboards for defect cards and joint evidence cards. Same to be located either on cross tie under car or inside of side sill at end of car, or on center sill of cars equipped with center sills only. Size of card to be not less than 5½ by 9 in.*

(2) *All steel cars not equipped with cardboards for Bad Order cards, routing cards, return cards, etc. Same to be located on each side of car, near bottom at left hand end, or on end of end sill, and on center sill on cars equipped with center sills only. Size of cardboard to be not less than 5½ by 9 in.*

(3) *Steel box cars not equipped with cardboards for special explosive and other placards, as required by the I. C. C. Same to be located on side doors and both ends of car. Size to be not less than 12 by 12 in.*

(4) *All cardboards on steel cars must be secured with rivets or bolts with ends riveted over nuts.*

RULE 56

In view of the fact that cars will not now be accepted in interchange unless equipped with all metal brake beams, it is recommended that Rule 56 be eliminated from the Rules of Interchange.

RULE 57 (Delivering Company Responsible)

The committee recommends that Rule 57 be modified to read in accordance with the proposed form shown below:

Cars not equipped with A. R. A. standard 1⅜-in. air brake hose. For label, see page 71.

The use of a rectangular label in addition to the band label is optional with any railroad, providing space, *preferably 2 in., is allowed between the two labels.*

RULE 59 (Delivering Company Responsible)

The committee recommends that a new rule be added to the Rules of Interchange to be designated as Rule No. 59 to read as follows:

Cars offered in interchange with missing dirt collectors where cars are stenciled that they are so equipped.

RULE 60

The committee recommends that the following be added to the last paragraph of this rule:

The stenciling showing air brakes cleaned must not be changed unless all work is properly performed as required by the standard instructions for Annual Repairs to Air Brakes on Freight Cars.

RULE 62

The committee recommends that the second paragraph of Rule 62 be modified to read in accordance with proposed form shown herewith.

PROPOSED FORM

In replacing brake shoes on foreign cars, new *reinforced back* shoes must be used to justify bill.

RULE 66

The committee recommends that this rule be changed to provide that the expense of periodical repacking of journal boxes shall be assumed by the handling line and that item of lubrication be restored in Rules 1 and 108.

RULE 86

The committee recommends that the effective date of fourth paragraph of Section (b) of this rule be extended to October 1, 1922.

RULE 87

In order to show clearly the intent of this rule, the committee recommends that reference to Rule 70 be eliminated in the first paragraph and that the second paragraph be changed to read as follows:

The company making such improper repairs must place upon the car, at the time and place the work is done, an A. R. A. defect card, which card must state the wrong repairs made, *and which will be authority for bill for both material and labor for correcting the wrong repairs.*

RULE 88

In order to clearly show the intent of this rule, the committee recommends that the first paragraph be modified as shown below:

In order that repairs of owners' defects may be expedited as fully as possible, foreign or private line cars may be repaired by the handing line by using material from their own stock instead of ordering *from owner special material not specified in last paragraph of Rule* 122, in which event the repairing line must issue its defect card for the labor only of correcting such improper repairs, and defect card should be so marked.

RULE 112

Upon recommendation from the Committee on Car Construction the Arbitration Committee recommends that a fourth paragraph be added to Class E under the table showing reproduction cost per pound for freight equipment, reading as follows:

All wood, equipped with metal draft arms, extending 24 inches or more beyond center line of body bolster and with body bolster of sufficient strength to transmit buffing and pulling shocks to all longitudinal sills.

The reference to draft arms in Note 1 should be eliminated.

Section (d), which was intended to provide for settlement covering so-called rebuilt cars, has been found to be impracticable of application. The committee recommends the abrogation of this provision and the substitution of a new Section (d) reading as follows:

If construction of car has been altered to the extent of placing it in a higher class for which a higher rate per pound is allowed under section (b), settlement shall be made at such higher rate per pound and according to the stenciled lightweight on car at date of destruction, and the depreciation shall be figured from date car was originally built at the rate applying to car as destroyed. This provision shall be retroactive in application to unsettled cases under the 1920 *Rules.*

All references to rebuilt cars in this rule should be eliminated.

RULE 114

In view of the adoption by special letter ballot of the proposition of replacing ends of cars when broken out, the committee recommends that this rule be modified in accordance with proposed form shown below:

If the company on whose line the car is destroyed elects to rebuild the car, the original plan of construction must be followed, and the original kind and quality of materials used, except that metal draft arms extending beyond body bolster, steel draft members extending full length of car, transom draft gear, steel center sills or steel underframe should be applied and be of such design as will meet the recommended practice of the Division for reinforcing existing cars.

On house cars (other than refrigerator cars) with steel underframes or steel center sills, having a center sill area of not less than 24 *sq. in., when an end requires repairs consisting of new posts and braces, the ends shall be replaced with ends specified for new cars, this to be done by or under the direction of the car owner.* No allowance shall be made for betterments not authorized by car owner.

NOTE.—See Per Diem Rule 8.

RULE 120

The committee recommends that the following changes and additions be made in this rule:

Add the following item in the table under "Flat Cars," Section (b):

All steel or steel underframe........................$150.00

Change Section (c) to read as follows:

(c) The owner shall authorize repairs or destruction of car *within* 30 *days from date of notification.*

Add the following paragraph to Section (e):

At the time of authorizing destruction the owner shall furnish handling line statement showing estimated weights of material in car for which credit is due to assist handling line in arriving at proper credit. Couplers, wheels, axles and journal bearings shall be credited on basis of scrap prices shown in Rule 101 *for such items.*

Insert the following paragraph between the present first and second paragraphs of Section (f):

On house cars (other than refrigerator cars) with steel underframes or steel center sills, having a center sill area of not less than 24 *sq. in., when an end requires repairs consisting of new posts and braces, the ends shall be replaced with ends specified for new cars, this to be done by or under the direction of the car owner.*

PASSENGER CAR RULES

RULE 2

The committee recommends that Section (b), Rule 2, be modified as shown below, in order to more clearly define the intent of this requirement:

Cars, loaded or empty, using lighting outfits operated by engines using *inflammable liquids with flash point* 80° *F. or lower, such as gasoline, motor fuel and alcohol,* will not be accepted in interchange. *This will not apply to lighting outfits operated by petroleum oils with flash point above* 80° *F., such as kerosene or illuminating oil.*

RULE 12

The committee recommends that Section (b) of this rule be modified as shown below:

The billing repair card must specify for journal bearings applied and removed, whether solid, filled or other kind, length of journal and box number *as marked on truck.*

The report is signed by T. H. Goodnow (Chairman), Chicago & North Western; J. J. Hennessey, Chicago, Milwaukee & St. Paul; J. Coleman, Grand Trunk; F. W. Brazier, New York Central; J. E. O'Brien, Missouri Pacific; T. W. Demarest, Pennsylvania System, and G. F. Laughlin, Armour Car Lines.

Prices for Labor and Material

During the past year the committee has made certain investigations, and submits the following report on freight car Rules 101, 107, 111 and 112, and Rules 21 and 22 of the passenger car code.

The material prices set forth in the accompanying recommendations for 1921-22 rules are based on the average prices paid by five large representative roads during 1920, supplemented by numerous current quotations from several large railway supply houses. As in the present code, all material prices include suitable allowances to cover freight transportation charges, direct and indirect store expense, fabricating labor when involved, and interest on stock investment, based on average monthly inventory balance multiplied by interest rate and result divided by total annual material disbursements.

In recommending many of the material prices, due consideration was given to the fact that the roads had stocked up on materials at prices effective before the decline, and therefore the full effect of the recent decline in prices will not be represented in the prices recommended for next year.

In establishing prices for practically all second-hand materials, the same percentage of cost new as prevails in the present rules was used. Scrap materials were averaged and current market prices less transportation charges to scrap plant were set up as credits.

Labor allowances shown in hours and tenths are substantially the same as those in the present code, which were based on time studies in 1915 and 1916, one of the most important exceptions being the fact that certain allowances for sills, bolsters, etc., which in the present code include jacking of the car, have been modified so that the jacking cost is omitted and is to be added as a separate operation where consistent. It is felt that this will be of considerable advantage to bill clerks throughout the country in that there will be removed the necessity for deducting under certain combinations the jacking price heretofore included in two or more of the operations in the combination.

The principal labor rate per hour (Item 172, Rule 101), is recommended at $1.20; the same as authorized in the existing rules. As noted above, no changes have been made in the labor allowances as a whole nor in the rates per hour, this for the reason that overhead studies made on six representative roads during October and November, 1920, also investigations made in February and March, 1921, as to actual time consumed on these roads in performing the work as compared to the arbitrary allowances authorized under the rules, indicate that the roads of the country, on the average, are being fairly compensated under the rules for the work performed by them on foreign cars.

The report is signed by A. E. Calkins (chairman), New York Central; Ira Everett, Lehigh Valley; T. J. Boring, Pennsylvania System; I. N. Clark, Grand Trunk; H. G. Griffin, Morris & Company; J. H. Milton, Chicago, Rock Island & Pacific; C. N. Swanson, Atchison, Topeka & Santa Fe; E. H. Weigman, Louisville & Nashville, and A. E. Smith, Union Tank Car Company.

RULE 101

[The important changes in this rule are increases in most of the prices for air brake material, decreases in the prices for couplers and coupler parts and the discontinuance of price for the periodical repacking of journal boxes.—EDITOR.]

RULE 107

The committee recommended the change of the first paragraph of Rule 107 to read as follows:

The following table shows the labor charges which may be made for performing the various operations shown. The labor allowances include all work necessary to complete each item of repairs, *unless the rules specifically provide that in connection with the operation additional labor may be charged for the R. & R. or R. of any item which must necessarily be R. & R. in connection therewith.*

[The changes in time allowances are largely confined to reductions due to not including jacking of the car in operations which generally require the car to be raised.—EDITOR.]

RULE 111

[The principal change in this rule is the elimination of item 8, tightening cylinder and reservoir when loose.—EDITOR.]

PASSENGER CAR RULES 21 AND 22

[Item 3A was added to Rule 21, allowing one hour for slackening buffer in order to R. & R. or R. coupler knuckle, lock or pin. A number of adjustments in material prices are shown in Rule 22.—EDITOR.]

Report of Car Construction Committee

Salt Water Drippings

Conference has been held with representatives of the principal interests using brine valves and it is the opinion that the various devices now used will, with proper maintenance, perform their functions, that the users of such devices are fully advised as to their necessity and should be notified that they must have all cars with brine tanks equipped by January 1, 1922, and that no further extension of time will be granted after that date. It is recommended that paragraph "F" of Interchange Rule 3 be modified to correspond with the above.

End Doors for Box Cars

In the report of 1920 the following recommendation was overlooked when preparing the sheet for letter ballot:

In 1913, the Master Car Builders' Association adopted as recommended practice, that end doors must be so constructed that, when closed, they lock automatically by means of a lock accessible from the inside of the car, thus avoiding the necessity of taking seal records. Sheet 30 shows a design of inside fastening which is not automatic, and your committee recommends that recommended practice adopted in 1913 should be advanced to standard, and that the design of inside latch shown on Sheet F should be removed, and a note substituted that the fastening should lock the door automatically from the inside of the car.

It is recommended that this be now submitted to letter ballot.

Minimum Thickness for Backs of Journal Bearings

Requests to fix a minimum thickness, because, at times, too much wear is allowed before removal, led to issuing Circular No. S III—108, asking whether such limits are necessary, and, if so, what the limits should be.

According to the majority of replies received, it is desired to fix a standard minimum thickness for backs of journal bearings, as follows:

Class of Bearing	A	B	C	D	E	F
Size of journal, in.	3¾ by 7	4¼ by 8	5 by 9	5½ by 10	6 by 11	6½ by 12
Min. Thickness of back, in.	½	9/16	⅝	11/16	¾	13/16

It is suggested that this be adopted as recommended practice.

Gages for Bearings and Wedges

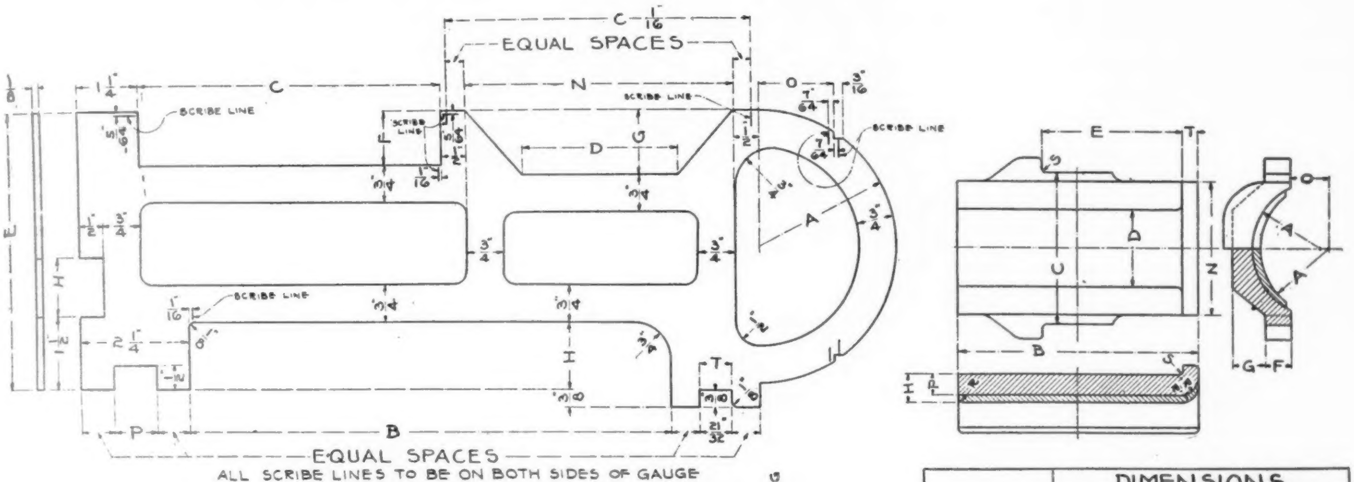
Attention was directed to a growing demand for these

gages and that standards should be provided. The committee's recommendations for such gages are shown in Figs. 1 and 2 and it is suggested that these be adopted as recommended practice, the present separate gages to remain as standard.

Dust Guards

Since pressed or cast steel and malleable iron journal boxes with round bottom dust guard cavities have come into more general use, it is advisable, in order to avoid duplicating reserve stock for repairs, to make the bottom of all dust guards semicircular. Such dust guards can be used in boxes with either square or round bottom dust guard cavities.

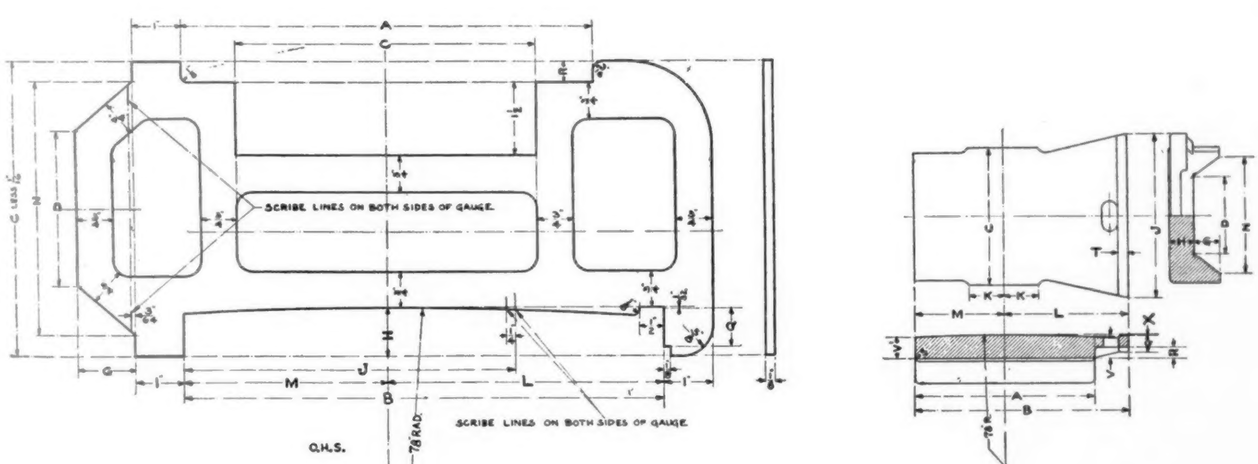
The committee recommends that the dust guard shown in Fig. 3 be made standard. The dust guards illustrated show the round bottom and otherwise were changed in dimensions to better fit the standard journal boxes.



A R A CLASSIFICATION	SIZE OF JOURNAL	DIMENSIONS-INCHES										
		A	B	C	D	E	F	G	H	N	O	P
A	3¾" × 7"	1 57/64	6 25/32	4 17/32	2 1/32	3 31/32	29/32	1 1/8	1 1/16	3 25/32	57/64	3/4
B	4¼" × 8"	2 9/64	7 25/32	4 29/32	2 11/32	4 15/32	7/8	1 9/32	1 1/16	4 13/32	1 1/64	3/4
C	5" × 9"	2 33/64	8 25/32	5 21/32	3 5/32	5 5/32	1 1/16	1 7/32	1 3/16	4 29/32	1 25/64	7/8
D	5½" × 10"	2 49/64	9 25/32	6 5/32	3 5/32	5 21/32	1 3/32	1 5/16	1 3/16	5 13/32	1 33/64	7/8
E	6" × 11"	3 1/64	10 25/32	7 5/32	3 17/32	6 19/32	1 9/32	1 1/2	1 5/16	6 9/32	1 33/64	1
F	6½" × 12"	3 17/64	11 25/32	7 21/32	4 1/32	7 3/32	1 15/32	1 9/16	1 7/16	6 17/32	1 41/64	1 1/8

	DIMENSIONS											
	A	B	C	D	E	F	G	H	P	R	S	T
MAY BE GREATER BY	1/32"	1/32"	1/32"	1/32"	1/16"	1/32"	3/64"	1/16"	1/16"	1/16"	0	1/32"
MAY BE LESS BY	1/64"	1/32"	1/32"	1/32"	1/32"	3/64"	0	1/32"	0	0	3/32"	1/16"

Fig. 1—Journal Bearing Gage

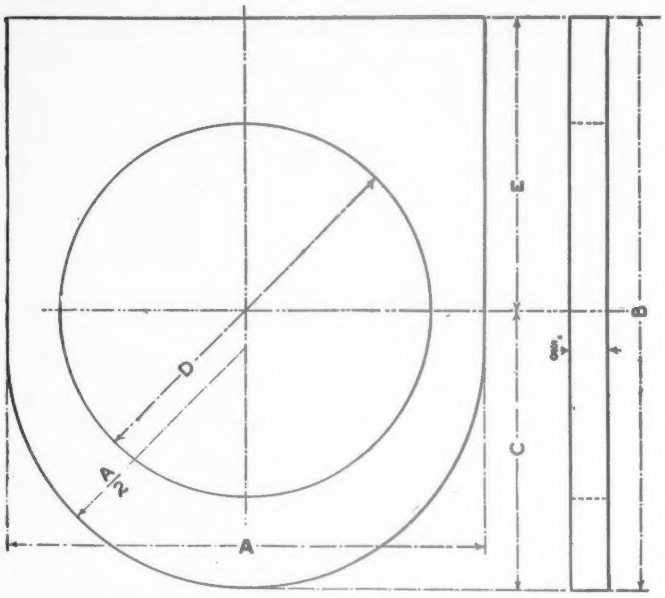


A.R.A. CLASSIFICATION	SIZE OF JOURNAL	DIMENSIONS IN INCHES											
		A	B	C	D	G	H	J	L	M	N	Q	R
A	3¾" X 7"	5 7/16	6 19/32	4 17/32	2 1/16	1	25/32	5 1/8	3 7/8	2 23/32	3 5/8	23/32	3/16
B	4¼" X 8"	6 7/16	7 25/32	4 29/32	2 11/32	1 1/16	29/32	5 1/8	4 9/16	3 7/32	4 1/16	27/32	3/16
C	5" X 9"	7 7/16	8 25/32	5 21/32	3 3/16	1 1/16	1 1/32	6 7/8	5 1/16	3 23/32	4 3/4	23/32	7/16
D	5½" X 10"	8 7/16	9 27/32	6 5/32	3 3/16	1 3/16	1 1/32	6 7/8	5 5/8	4 7/32	5 7/32	23/32	7/16
E	6" X 11"	9 7/16	10 27/32	7 5/32	3 9/16	1 3/8	1 5/32	7 7/8	6 1/8	4 23/32	6 1/8	25/32	1/2
F	6½" X 12"	10 7/16	11 27/32	7 21/32	4 1/16	1 1/2	1 13/32	8 3/8	6 5/8	5 7/32	6 7/16	7/8	21/32

	DIMENSIONS																	
	A	B	C	D	G	H	J	K	L	M	N	Q	R	S	T	V	V'	X
MAY BE GREATER BY	1/16"	1/32"	1/32"	1/32"	0"	1/32"	1/8"	1/8"	1/32"	1/32"	1/32"	0"	1/16"	1/16"	1/16"	1/32"	1/32"	1/32"
MAY BE LESS BY	1/16"	1/32"	1/32"	0"	3/64"	1/16"	1/8"	1/8"	1/16"	1/16"	0"	1/16"	1/16"	1/16"	1/16"	3/32"	3/32"	1/32"

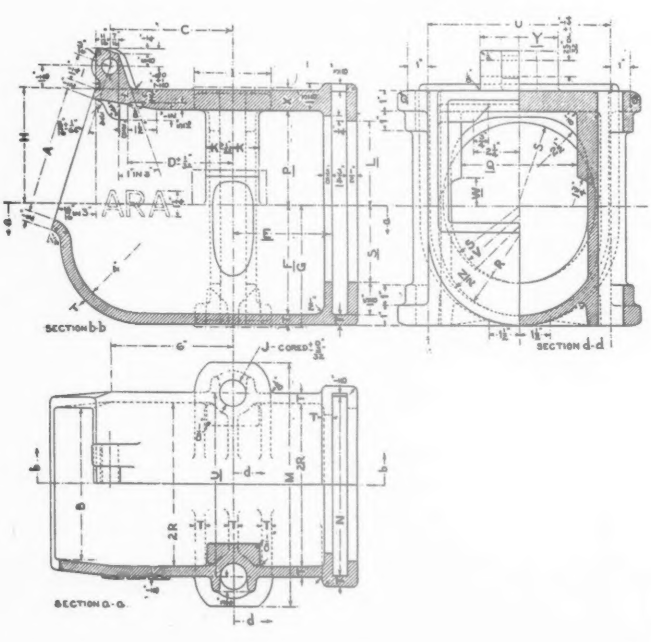
V AND V' MUST NOT DIFFER MORE THAN 1/16" ON ANY WEDGE.

Fig. 2—Wedge Gage



CLASSIFICATION OF GUARD	SIZE OF JOURNAL	A	B	C	D	E
C	5 X 9	8	9½	4⅝	6 3/16	4⅞
D	5½ X 10	8⅞	10	4⅞	6 11/16	5⅛
E	6 X 11	10⅝	10¾	5⅛	7 5/16	5⅝
F	6½ X 12	11	11⅝	5⅜	7 13/16	6¼

Fig. 3—Recommended Form of Dust Guard



Classification of Box.	Size of Journal.	A	B	C	D	E	F	G	H	I	J	K	L	M
C	5 by 9	6¼	7¾	6 1/16	5 3/16	4⅞	5⅜	5⅞	5⅝	4¾	1¼	1 5/16	4⅛	12
D	5½ by 10	6¼	7¾	6 9/16	5¾	5⅜	5⅝	6⅛	5⅞	5¾	1⅜	1 5/16	4⅜	12½
E	6 by 11	7⅜	8¾	7 1/16	6¼	5⅞	5⅞	6½	6⅜	6¼	1½	1¾	4¾	14¼
F	6½ by 12	8⅝	9¼	7 9/16	6¾	6⅜	6⅛	6⅝	7	7¼	1⅝	1¾	5⅛	14¾

Classification of Box.	Size of Journal.	N	O	P	Q	R	S	T C.I.	T MC. S.C.	U	V	W	X	Y
C	5 by 9	8⅞	1½	4⅝	5¾	4	3¾	½	¼	9	3⅜	1⅜	1	3⅞
D	5½ by 10	9¾	2	4⅞	6¼	4	4	½	¼	9½	3 11/16	1½	1	3⅞
E	6 by 11	11½	2½	5⅜	7¼	4⅝	4⅝	⅝	5/16	10½	4	1⅝	1⅛	4⅜
F	6½ by 12	11⅞	2½	6	7¾	5⅛	4⅝	....	⅜	11	4¼	1½	1⅛	4⅜

Fig. 4—Proposed Standard C, D, E and F Journal Boxes

Journal Boxes

To meet various suggestions for change, and to increase uniformity of standards, we submit Fig. 4, showing journal boxes C, D, E and F, recommending that they be substituted for the present standards.

The bottom of dust guard pocket has been made semicircular, to reduce the cost of box. The angle of lid face has been made the same for all boxes. Various minor, or unimportant, dimensions have been unified. No changes affecting interchangeability, or serviceability, have been made.

Springs

Complaints relating to the unsatisfactory results from standard springs have been increasing rapidly. The causes of the trouble, according to the analysis of your committee, are: (1) Unsatisfactory process of manufacture; (2) quality of material; (3) irregular surface of spring ends, and (4) improper application of shims under or over springs to raise the car body to normal height. The result is that many springs either break or take a permanent set.

The remedy recommended is: (1) To improve the method of manufacture by better control of heating and tempering for more uniform results, and to obtain greater uniformity of coiling; (2) to use alloy steel; (3) to grind the ends of the springs to present a flat bearing surface of at least two-thirds the circumference at right angles to the axis of the spring; (4) to prescribe that shims, placed under or over the springs, shall consist of metal plates with parallel surfaces,

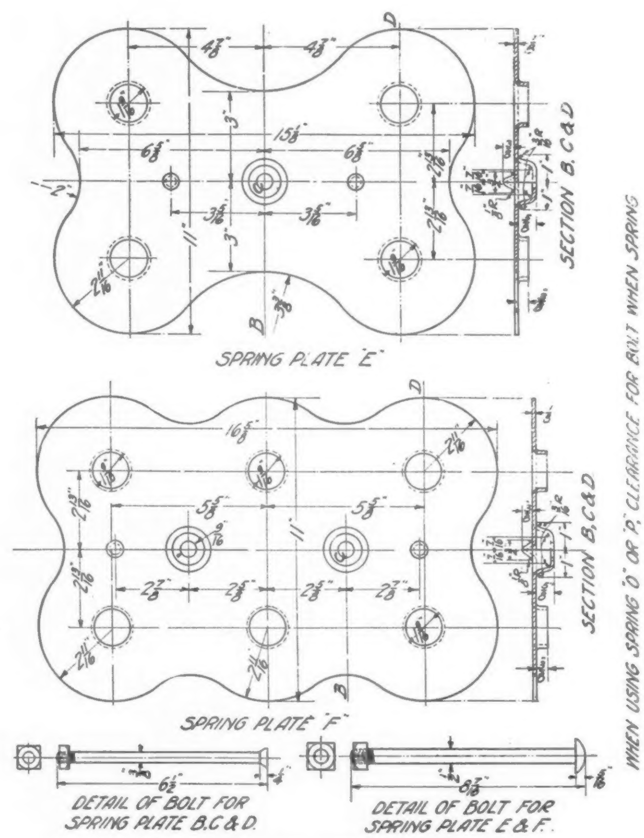


TABLE OF SPRING GROUPS

CLASS OF TRUCK	CLASS OF SPRING	No. OF COILS No. 1	No. OF COILS No. 2	SPRING PLATE	HEIGHT INCLUDING PLATES FREE	HEIGHT INCLUDING PLATES SOLID	CAPACITY SOLID	CAPACITY FOR H=7½"
2B	L	4	0	B	8½"	6½"	61900	30950
2C	M	4	2	C	8½"	6½"	70420	35210
2D	N	4	4	D	8½"	6½"	78940	39470
2E	O	5	5	E	8½"	6½"	98675	49338
2F	P	6	6	F	8½"	6½"	118410	59205

Fig. 5—Truck Spring Details

and (5) to design the springs for a unit stress, when solid, of close to 100,000 lb. per sq. in., using the present diameters of bars, thereby materially increasing the capacity and range of deflection.

These changes should result in: (1) Material decrease in shock on side frames; (2) increased life of springs, and (3) decrease of maintenance cost and car delay.

It is recommended that the springs classified "L," "M," "N" and "O," as illustrated, in Figs. 5 and 6, be adopted as alternates for springs "B," "C," "D" and "H," and that alternate spring "P" be added for use with 2/F trucks.

The committee requests that railroads try out these springs thoroughly, in order to be in position later to vote on their adoption as standard. It is recommended that interchange rules be formulated to protect the alloy steel springs against being replaced with ordinary springs.

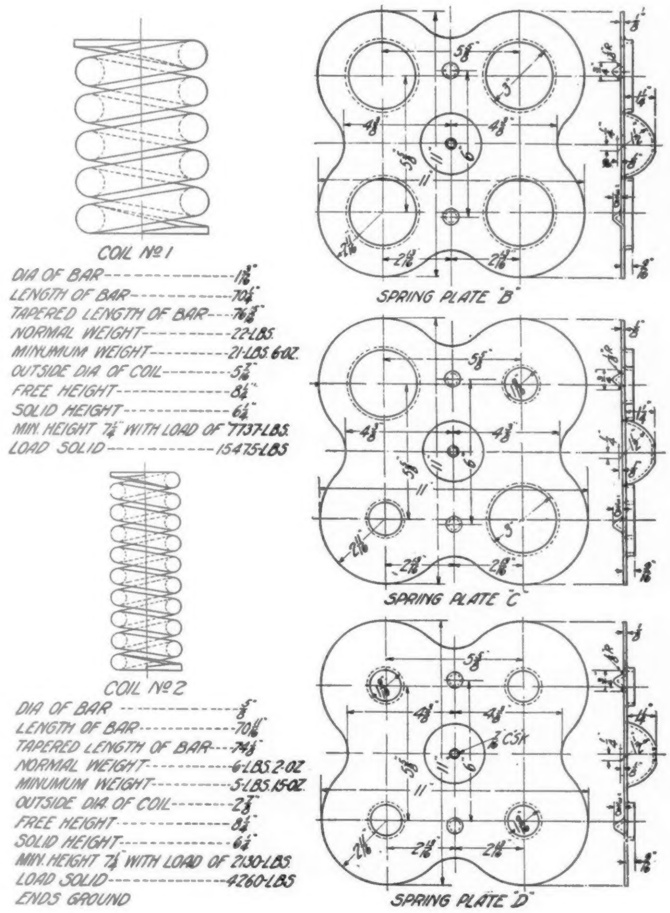


Fig. 6—Truck Spring Details

The secretary has referred this to the Committee on Specifications and Tests for Materials, requesting preparation of specifications.

Fundamentals

Inquiry relating to fundamentals, and their meaning, indicated the necessity of describing those pertaining to minimum areas more in detail. The minimum area between rear followers of the center sill construction is the whole area in compression under end force, without deducting for rivet and other holes, which are filled with metal.

In the formulæ on which former requirements were based, page 772, 1920 Proceedings, line "e," under heading "For center sills between rear followers," the word "tension" should have been omitted, making it read:

The minimum area = 2.5 T.

The tension and bearing area requirements, but not the shear area requirements, shall be governed by the value of the steel. For bearing area between surfaces of different grades of steel in contact, the value of the lesser grade of steel shall govern. For grade "A" steel, for which the product of elastic limit in pounds multiplied by the elongation in per cent is not less than 700,000, the areas given are required. For grade "B" steel, for which the designated product is not less than 850,000, the given areas may be reduced by 12½ per cent.

It was stated that the adopted height from rail to top of truck side bearings of 27⅝ in. would prevent the use of roller, ball or rocker side bearings. The dimension given refers only to flat truck side bearings.

The intent of the committee is to make designs that will establish fixed conditions, permitting the use of detail designs standardized by the Association, or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts, or group of parts, are the equivalent in strength and safety of, and interchangeable with, the standard part or group of parts replaced. This will permit using any special detail such as top side bearing, which is interchangeable with, and equal in strength to, the side bearing that may be standard, or special top and bottom side bearings, which as a group are similarly interchangeable with the standard top and bottom side bearings as a group.

The standards should be made attractive for use by being as good or better than parts that may be substituted, rather than by making their use compulsory.

Truck Design

A subcommittee of the Committee on Car Construction, in co-operation with the Truck Committee of the Manufacturers Association, are engaged in the design of cast steel side frames and bolsters. They have considered the limits of dimensions fixed at the last meeting of the Mechanical Division and have given full consideration to the previously recognized dimensions of the M. C. B. Association, and to the designs that were put into effect by the United States Railroad Administration.

The manufacturers' committee has met with the subcommittee on two occasions, each time submitting for consideration designs in detail representing various ideas in view, but up to this time no single design has been brought out that could be presented as a recommendation for standard. It is possible that more than one design will have to be considered, with alternates.

Standard Car Design

Pending the development of complete A. R. A. car designs, freight cars according to the essential standards of the American Railway Association may be ordered from any car builder according to the following:

Type	U. S. Spec. No.
Single sheath box	1001
Steel box	1341
55-ton hopper	1005
70-ton hopper	1007
70-ton gondola	1755
50-ton gondola	1004
40-ton truck	1274
50-ton truck	1276
70-ton truck	1241

The height of center plates should be specified as 26¾ in., as more fully described in American Railway Association, Mechanical Division, Circular S III-189. This increased height of center plate introduces eccentricity as between the line of shock and the axis of the center sill sections, which changes the ratio of stress to end load, to offset which, it is necessary to add two bottom angles to the center sills if the sectional area of the center sill is desired to be 30 sq. in. This would add about 500 lb. to the weight.

The height of sides of car, A. R. A. standard, is 8 ft. 6 in.

minimum inside. In event cars are ordered to the height shown in the drawings (9 ft.) no change in drawings is entailed. For the minimum height of 8 ft. 6 in., dimensions affected by the height, including the dimensions of box car doors, must be changed accordingly.

The report was signed by W. F. Kiesel, Jr. (chairman), Pennsylvania System; A. R. Ayers, New York, Chicago & St. Louis; C. E. Fuller, Union Pacific; J. C. Fritts, Delaware, Lackawanna & Western; C. L. Meister, Atlantic Coast Line; J. McMullen, Erie; T. H. Goodnow, Chicago & North Western; John Purcell, Atchison, Topeka & Santa Fe; W. O. Moody, Illinois Central; J. A. Pilcher, Norfolk & Western; H. L. Ingersoll, New York Central; W. H. Wilson, Northern Pacific, and F. W. Mahl, Southern Pacific.

Report of Committee on Loading Rules

During the past year conferences were held with the steel shippers, and also with the stone shippers of the Bedford, Indiana, district to consider suggestions offered by them for changes in the existing rules.

Trial shipments of twin loads of structural steel over five feet in height and having the center binder omitted were sent out at request of the steel shippers to determine the necessity for center binders. The information obtained through these trial shipments was not conclusive and the trial has been further extended.

General Rules

The following detailed changes in the Loading Rules are submitted for approval:

RULE 5

Changed "80,000" to "60,000" in second and third paragraph. Revised table to show 95,000 lb. as total weight of car and lading for cars of 60,000 lb. marked capacity. *Explanation:* Rule changed to provide limits for 60,000 lb. capacity cars on basis of axle capacity, to conform with Interchange Rule 86.

RULE 23

Revised to read as follows: "If, in loading cars, it is impossible to clearly ascertain whether the restrictions given in General Instructions under paragraph 8 are complied with, the following table may be used." *Explanation:* Reference to General Rule 9 has been omitted, as this rule refers to twin or triple loads. Rule 23 and the accompanying table pertains to single loads only.

Table of weights revised. *Explanation:* Limits for 100,000 lb. capacity cars revised to make these limiting weights consistent for various lengths of cars. The word "average" added to heading of second column to clarify the meaning. Thirty and 32 ft. cars omitted from the table account of no longer being used. Thirty-six, 38 and 48 ft. cars added to the table to take care of existing cars.

Group I—Lumber, Logs, Etc.

RULE 101

Add the following sentence to end of the rule: "Lumber or timber less than 12 ft. in length should not be loaded on flat cars or above the sides or ends of gondola cars."

Group II—Structural Material, Castings, Etc.

RULE 201

Omit last sentence from the rule, to clarify the meaning.

RULE 202

Fourth sentence of third paragraph revised to read as follows: "Short material may be loaded on car floor, if equally distributed over entire floor; total weight of entire lading must not exceed the load weight as per General Rule 5." *Explanation:* Reference to "capacity" changed to "load weight" to conform with reference to "load weight" in third sentence of third paragraph.

RULE 213

Third sentence of rule changed to read as follows: "The blocking should never consist of less than one 3-in. plank set on edge, or its equivalent, and must be secured from shifting by cleats nailed or bolted to the floor." *Explanation:* Revised to omit requirement for more than one plank for end protection.

RULE 217

First paragraph of rule changed to read: "When the lading consists of very flexible material, such as plates, no bearing-piece is required on the floor of the car, but blocking as prescribed by Rule 213 must be used to protect the end boards." *Explanation:* Revised to conform with Rule 213 for end protection.

RULE 227

Revised to read: "Material loaded on gondola cars with drop ends or on flat cars, as shown in Figs. 62 and 63, must have one hardwood bearing-piece not less than 10 in. by 10 in. for loads up to 65,000 lb. per bearing-piece, and not less than 12 in. by 12 in. for loads exceeding 65,000 lb. per bearing-piece. (See General Rule 31-A for light loads.)" *Explanation:* Requirement for ⅞-in. bolts to secure bearing-pieces has been omitted. Bearing-pieces are secured by 1¼-in. rods passing through bearing-piece and floor of car.

RULE 250

Second paragraph changed to read: "Wrought iron pipe should not be loaded inside of larger sizes of pipe unless below the ends or end gates of car."

RULE 260

Insert words "or gondola" after the word "flat" in marginal reference of rule. Insert words "or gondola" after word "flat" in first line of first paragraph.

RULE 265

Revised as follows and drawings changed to accord therewith:

"Metal sheets loaded in box cars should be secured in accordance with Figs. 90, 90-A, 91 and 92. Sheets in each pile should be preferably of uniform size and there must be at least two 2 in. by 4 in. uprights secured to inside of car at the end of each pile to provide a uniform bearing surface and to prevent the sheets from cutting through the end lining of car; also upright strips not over one inch thick should be used between the lading and sides of the car.

"The piles must be securely wedged apart at least at two points by braces consisting of 2-in. by 4-in. uprights against the piles, securely wedged apart at top and bottom by 2-in. by 4-in. pieces, as per Figs. 90, 90-A and 91. Each upright piece to be secured by two 2-in. by 4-in. cleats nailed to floor to prevent shifting, and tied together at top by not less than 1-in. by 4-in. longitudinal strips to prevent shifting.

"The bracing at ends of piles toward center of car shall consist of one upright piece 2 in. by 4 in. against end of pile, backed up by one upright piece 2 in. by 8 in. against side of car, both to extend full height of load and be securely nailed to side of car as per Fig. 90; and, in addition, there must be one piece of 2 in. by 4 in. extending across doorway at top of load, securely wedged against bracing of load in opposite end of car, also one piece of 2 in. by 4 in. extending

from upright at end of pile to doorway and securely nailed to side posts and braces as per Fig. 90.

"Where height of load exceeds 30 in. it will be necessary to apply additional longitudinal bracing at center of load.

"Uprights to be secured at bottom by two 2-in. by 4-in.

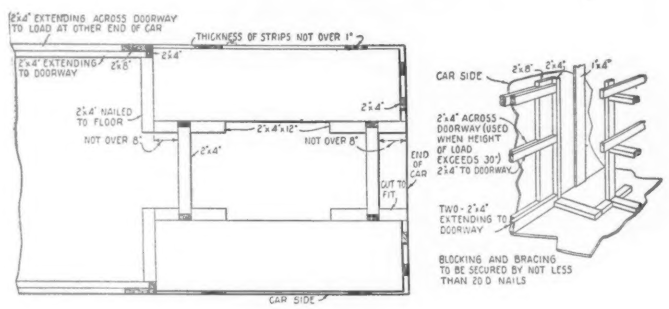


Fig. 90

pieces extending to doorway, and one piece of 2 in. by 4 in. extending full width of pile, securely nailed to floor as per Fig. 90.

"Wedges at bottom of load are optional; if used, they should conform to Fig. 91, and where width of pile exceeds 28 in. three wedges should be used.

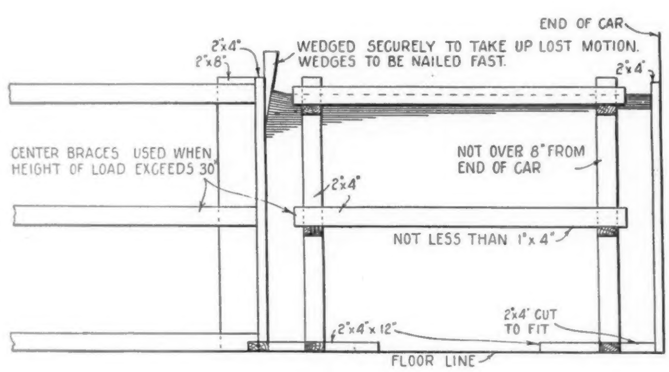


Fig. 90-A

"In all cases, where there is space between ends of sheets and uprights at top of pile, wedges must be used as per Fig. 90-A.

"When oiled sheets are loaded they should be placed on

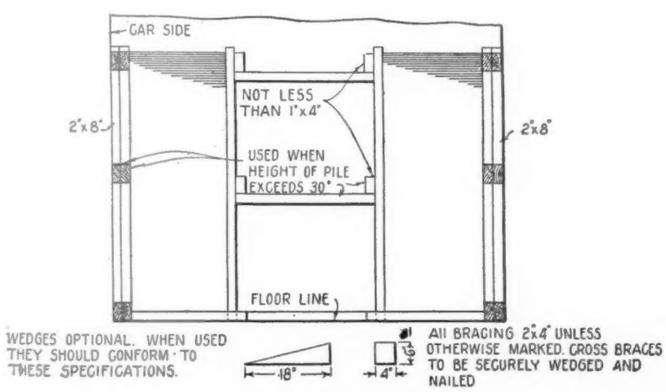


Fig. 91

suitable strips and heavy paper used to prevent oil stains on the floor of car.

"There may be more than one pile of sheets in each corner of car, provided there are at least two 2-in. by 4-in. pieces between ends of piles, secured in an upright position and extending from car floor to at least 2 in. above top of pile and each pile is braced against side of car.

"Bundled metal sheets loaded in box cars should be loaded in accordance with Fig. 92. After piling of sheets is completed, the center of pile should be compressed solid and top cross-piece *X* must be nailed and cleated to car sides. This cross-piece must also be further secured by having a

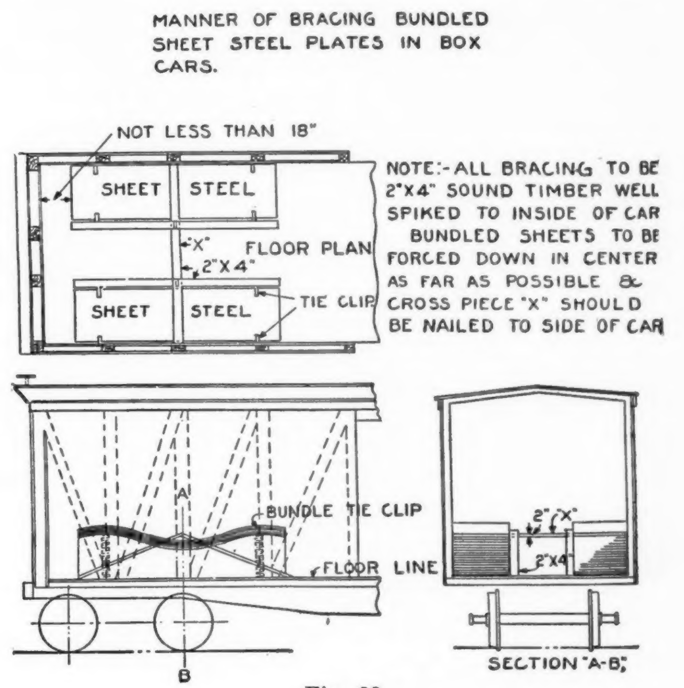


Fig. 92

2 in. by 4 in. placed against side of pile and nailed to floor of car and top of cross-piece.

"All blocking and bracing to be secured by not less than 20-penny nails."

Explanation: Rule and figures revised in conference with shippers to furnish more substantial blocking and bracing for this class of material, to better protect both lading and car.

Group IV—Concrete Culvert Pipe, Brick, Stone, Etc.

The following revisions of the stone loading rules are recommended as the result of conference with the shippers of stone:

RULE 401

Second paragraph revised to read as follows: "Where separating strips to keep lading clear of car floor are referred to in these rules, they should be sound wood, not less than 3 in. wide by 1½ in. thick. Such strips shall extend full width of stone and be placed approximately one-fifth the length of stone from each end. Where more than one strip is used to make the required thickness, the strips should be securely nailed together. In no case is it considered good practice to use more than two bearing-strips per length of stone. Stone longer than 10 ft. should, whenever practicable, be loaded over trucks." *Explanation:* Revised to include increase in size of separating strips; definite location for strips; strips to be nailed together where necessary; not more than two strips per stone; stone over 10 ft. long to be loaded over trucks; sound wood specified in place of soft wood.

RULE 405

First paragraph: Insert the following at end of second sentence: "See Rule No. 401 for minimum size of wood strips."

RULE 405

Insert the following paragraphs after second paragraph of rule:

"Where practical, the following method of loading should

be used for flagging, slabs or stone sawed on two sides.

"Slabs 2½ in. thick and less, shipped in quantities, to be loaded on edge, lengthwise of car. Where a few pieces only of this group of sizes goes on a car, such few pieces may be loaded flat on top of slabs not less than 4 in., but not more than four pieces in any one stack.

"Three-inch slabs shipped in quantities loaded flat should have a slab not less than 4 in. under each pile. There should be no more than eight 3-in. slabs in any one pile, either loaded on a 4-in. slab, or on the floor of a car. Three inch slabs longer than nine ft. must be loaded on edge or flat on a slab not less than 4 in. in thickness or not more than two on top of any shorter stack.

"Four-inch slabs shipped in quantities loaded flat on car to be loaded not more than eight slabs high. Where 4-in. slabs are loaded on slabs 5 in. thick or over, then the same amount may apply on slab as flat on car. Four-inch slabs longer than 10 ft. should, wherever possible, be loaded on slabs thicker than 4 in.

"Five-inch slabs shipped in quantities loaded flat on car to be loaded not more than eight slabs high. Where 5-in. slabs are loaded on slab 6 in. or over, then the same amount may apply on slabs as flat on car. Five-inch slabs longer than 11 ft. should, wherever practicable, be loaded on slabs thicker than 5 in."

Explanation: To provide definite rules for piling slab stone.

RULE 405

Third paragraph, second sentence, revised to read: "If necessary, to prevent stone from shifting past the end stakes, a standard board should be securely nailed to the inside of the end stakes and extend full width of stone." *Explanation:* Revised to indicate when board protection is required.

RULE 408

Marginal reference revised to include "stone sawed on more than two sides." First sentence of first paragraph revised to read: "Curbing and stone sawed on more than two sides when loaded lengthwise of car should have two standard stakes opposite each outside piece." *Explanation:* Rule revised to include stone sawed on more than two sides.

RULE 409

Second paragraph, second line, word "soft" changed to "sound." *Explanation:* To permit use of various woods that may be available.

RULE 410

The first paragraph revised to read as follows: "Mill block loaded lengthwise or obliquely on car should be protected on the sides and ends by cleats not less than 2 in. by 4 in., in section, extending at least three-fourths of length or width of stone or by not less than two wedges 3 in. by 3 in. on sides and 4 in. by 4 in. on ends, wedges to be not less than 14 in. long and securely nailed to floor of car at right angles to stone. When the width of stone exceeds 3 ft. 6 in., or length of stone exceeds 10 ft., the side and end protection must consist of not less than three wedges. If stone is loaded crosswise of car and width of stone does not exceed 3 ft., only one wedge will be required for side protection. All side and end cleats of wedges must be sound, straight grained lumber secured to floor of car by not less than 40-penny nails. When the stone is loaded close together or wedged apart, cleats or wedges are required on sides and ends of outside stone only. When such stone is loaded in tiers, standard end and side protection must be provided." *Explanation:* Reference to height of stone omitted. Provision included for use of wedges in place of cleats. Sound lumber secured by not less than 40-penny nails is specified for cleats and wedges.

Second paragraph revised to read: "Mill block containing as much as 100 cu. ft. resting on channel or scabbled surface not less than 25 sq. ft. or proportional for increased sizes must be so loaded that the weight of total lading will be uniformly distributed over the floor of the car." *Explanation:* Requirement of a layer of sand, cinders or crushed stone for supporting the stone has been omitted. Not essential for uniform bearing.

Third paragraph revised to read: "Gondola cars are preferable for such shipments, but if flat cars are used, the lading should be placed at least 18 in. back of end of car. When car is equipped with end stake pockets and stone is loaded closer than 18 in. to end, standard stakes 6 in. high should be used. When the stone does not engage both stakes, wedges in addition to stakes must be used. Each block of stone loaded lengthwise, crosswise or obliquely must be protected against creeping as specified in first paragraph of this rule. When two blocks of stone are loaded parallel and close to each other, or wedged apart, they will be considered as one stone as to cleating or wedging." *Explanation:* Provision made for end stake blocking where car is equipped with end stake pockets and stone is loaded closer than 18 in. from end.

Fourth paragraph revised to read: "If stone is placed lengthwise of car and is 4 in. or closer to side of car, two standard side stakes 6 in. in height must be placed opposite such stone in lieu of cleats or wedges on that side of stone. Stone must not be loaded obliquely when it is possible to load it lengthwise or crosswise of car." *Explanation:* Reference made to wedges to conform with change in first paragraph of rule.

Fifth paragraph omitted from rule. *Explanation:* Covered by first paragraph of revised rule.

Sixth paragraph: The following words, "when used," inserted after the word "cleat" in first line. *Explanation:* To conform with first paragraph of rule.

New paragraph added as follows: "In no case shall the height of stone be more than two times the smallest dimension resting on the car floor." *Explanation:* This paragraph establishes a limit for the height of stone in proportion to the base in accordance with the practice which is generally followed in loading large stone.

RULE 411

First paragraph, second sentence: Change the words "one and one-half" to "two." *Explanation:* To conform with first paragraph of Rule 410.

Group V—Automobile Loading

RULE 518

Rule revised to read: "The distance between any two vehicles, at the nearest point, loaded on a freight car must not be less than the following limits: 2 in. horizontally, 3 in. vertically with springs compressed and 4 in. vertically without springs compressed." *Explanation:* Revised to permit a 3 in. vertical clearance where cars are shipped with springs compressed.

End Stake Pockets for Flat Cars

In conference with stone shippers, the sub-committee of the Loading Rules Committee agreed to recommend to the Committee on Car Construction that end stake pockets be required on future flat cars. This subject is, accordingly, hereby referred to that committee.

The report is signed by R. L. Kleine (chairman), Pennsylvania System; J. J. Burch, Norfolk & Western; E. J. Robertson, Soo Line; J. E. Mehan, Chicago, Milwaukee & St. Paul; Samuel Lynn, Pittsburgh & Lake Erie; Ira Everett, Lehigh Valley; T. O. Sechrist, Louisville & Nashville; E. N. Harding, Illinois Central, and G. R. Lovejoy, Detroit Terminal.

Brake Shoe and Brake Beam Equipment

The 1920 Brake Shoe and Brake Beam Committee in its report presented at the last annual meeting engaged for the 1921 committee to give attention to eight subjects. These subjects have been given careful consideration and are hereinafter reported on as follows:

Gage for Determining Hanging Heights of Existing Beams

The value of such a gage is insufficient to warrant the expense incident to its development and manufacture for general distribution. The old types of cars on which wide variations of hanging heights exist and which prompted the idea of such a gage are gradually being eliminated. There is an increasing demand and tendency to standardize brake beams and hangings, which will eliminate the necessity for such a gage.

Code Governing Brake Beam Maintenance Practices

The committee recommends as the first progressive step the early adoption of a standard practice covering the reclamation of brake beams in such a manner that they will meet the standard specifications used in the purchase of new brake beams.

A sub-committee was appointed to submit a tentative standard practice and has submitted one which is deserving of the careful consideration of the association. It is submitted as a progress report and it is recommended that the report be submitted to the members of the association with the request that each submit his criticism to the committee to assist it in the final development of a standard practice that will satisfactorily meet the requirements. See Exhibit A.

Advisability of Brake Head Strength Test

This subject was referred to a sub-committee of engineers of tests which conducted some laboratory tests on 21 different types and capacities of brake beams representing the products of seven different manufacturers, at the Collinwood laboratory of the New York Central Lines, and submitted the report which is incorporated herein as a progress report. The conclusions reached by the sub-committee read in part as follows:

> Tests of brake-beam heads do not appear necessary if the load in service always comes upon the center lugs. However, if in the opinion of the Brake Beam Committee, the load is not always restricted to the center lugs, but is frequently carried principally on the toes, then a standard strength of head, and standard method of test for determining same, is desirable.

The committee believes that all of the stress on brake heads is frequently sustained by the top and bottom lugs and that brake head strength tests are a proper and reasonable requirement and should eventually be incorporated in the specifications. Accurate and practical methods of making such tests are, however, still obscure and will require further careful study and investigation by the committee. See Exhibit B.

Increasing the Initial Brake Shoe Thickness

In view of the adoption as standards of the association, of brake heads of the A, B and C depths last year to take care of existing brake beam clearance conditions, the committee deems it advisable that no changes be made in the standard brake shoe thickness of 1½ in. at this time.

Details of Top and Bottom Head Lugs

This subject refers to the recesses in the top and bottom brake head lugs which receive the top and bottom brake shoe lugs. The standard drawing does not show all of the dimensions and manufacturers were conferred with to determine the practice. It was found that the depth of the recesses is uniformly 1¼ in. from 17¾ in. radial line; the width at the opening is in practically all cases 1⅝ in. and at the bottom varies from 1⅛ in. in the majority of cases to 1 7/16 in.

The committee recommends that Section CC, Sheet M. C. B. 17, be revised to show the dimension 1⅛ in. as the width of the bottom of the recesses adjacent to the top and bottom brake head lugs.

Brake Shoe Key Design and Fit of Shoes, Head Face and Key

This subject was referred to a sub-committee for investigation and its report is submitted as a progress report. The investigation will be continued by the committee. See Exhibit C.

General Brake Beam Hanging

This subject was referred to a sub-committee for investigation and its report was forwarded to the Committee on Car Construction which has the matter under consideration in connection with standard truck design.

Reversible Strut

This subject is still under consideration and the committee has nothing to report at this time.

Standard Depth of Brake Head

Last year there were adopted as standards three depths of brake heads designated as "A," "B" and "C" to meet clearance conditions obtaining on various cars. The committee recommends that heads "B" and "C" be removed from the standards and their use be permitted as alternates where the standard "A" head cannot be applied.

Status of the No. 2 and No. 2 Plus Standard Brake Beam

The status of the No. 2 and No. 2 plus standard brake beams, as regards the weights of cars to which each should be applied, has received special consideration at different times during the year.

The Train Brake and Signal Committee and the Brake Shoe and Brake Beam Equipment Committee were requested by the Car Construction Committee to submit their joint recommendations on this subject. The joint meeting of the two committees referred to was held at New York on April 5, 1921, and the following motion was carried by a majority but not a unanimous vote:

> The Brake Shoe and Brake Beam Equipment and the Train Brake and Signal Equipment Committees have considered the matter of No. 2 and No. 2 plus brake beams and recommended that these beams be used on cars of the following weights for four-wheel trucks:

BRAKE BEAM	CAR WEIGHT
2	35,000 to 48,000 lb.
2 plus	48,000 to 58,000 lb.
3	Over 58,000 lb.

In the case of six-wheel trucks, the above weights should be increased 50 per cent for the beams specified.

Report of this action was submitted to the Car Construction Committee.

Formula for Brake Power on Freight Cars

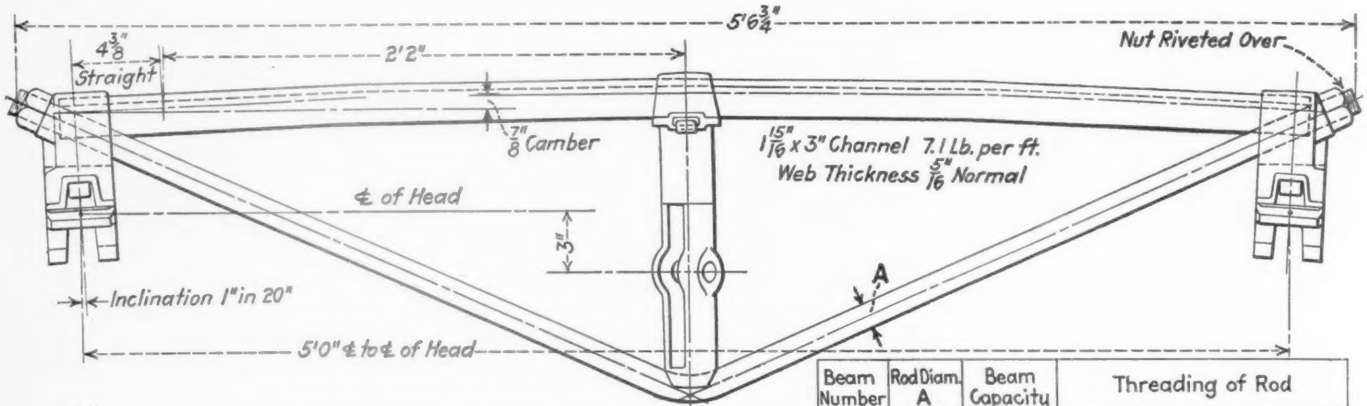
The Car Construction Committee in its last year's report recommended a new formula for brake power on freight cars.

The association requested the Train Brake and Signal Equipment and the Brake Shoe and Brake Beam Equipment Committees to submit joint recommendations on this subject. The joint meeting was held November 18, 1920, and a proposal to change the brake ratio as suggested was unanimously disapproved. An abstract of the report submitted to the Car Construction Committee follows:

The purpose of the proposed change in braking power is to

make the percentage of braking power more uniform on partially loaded cars in which there is a wide range in the ratio of light weight to loaded weight. While the proposed change will accomplish in a small measure the object sought, it will do so only by sacrificing the uniformity of braking power on empty cars. As the factor of retardation is highest when the cars are empty, it is essential that uniform braking power be maintained for empty cars.

The adoption of the proposed braking power formula will



Brake Beam with Central Head Hangings Only

Beam Number	Rod Diam. A	Beam Capacity	Threading of Rod
*2	1⅛"	12,000 Lb.	U.S. Std. 1⅛", 7 Thds. 2½" Long
*2+	1¼"	15,000 Lb.	U.S. Std. 1¼", 7 Thds. 2½" Long

result in increasing the percentage of braking power on high capacity cars, to a point in excess of the capacity of standard 10-in. freight brake equipment, and for comparatively low capacity tank cars the application of the formula in some cases will reduce the effectiveness of the hand brake. It also provides for a lower percentage of braking power on refrigerator cars weighing approximately 55,000 lb. and having 5 in. by 9 in. journals. Because of the relatively high speed at which these cars are handled and

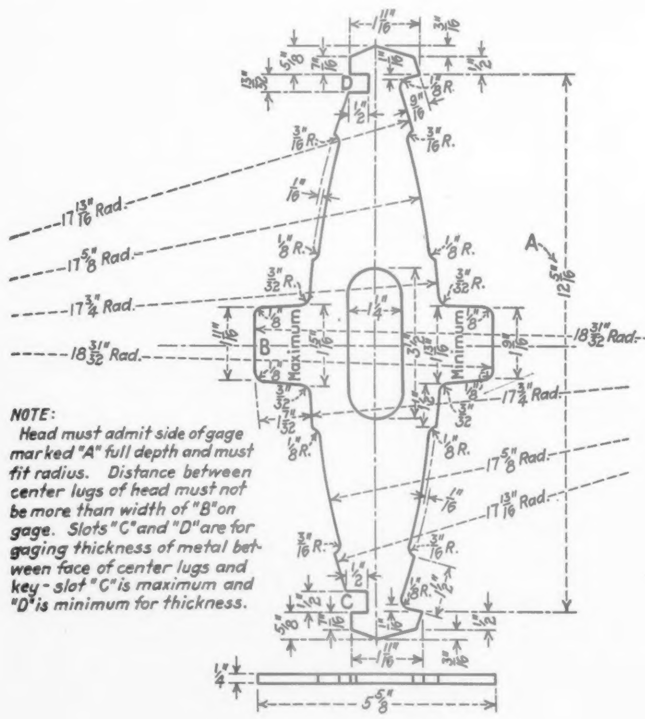


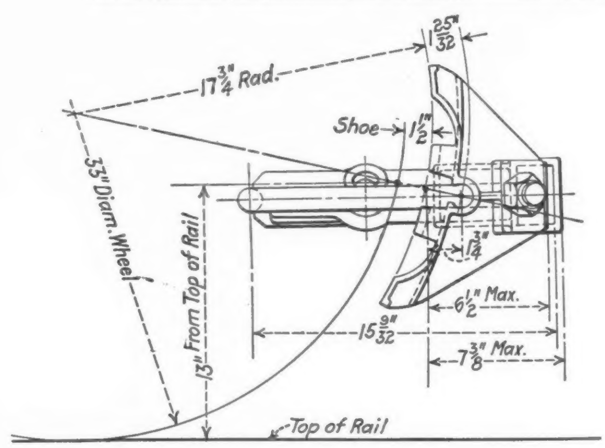
Fig. 1—Brakehead Gage

the character of their lading, a reduction in braking power is not considered desirable, especially in view of the fact that they are handled in short trains in which a high percentage of breaking power is less objectionable than in the case of long trains.

Standardization of Brake Beams Having Central Head Hangings

A start should be made to standardize brake beams having central head hangings only and having a maximum depth of brake head of 6½ in. and a maximum depth of brake beam of 7⅜ in. The committee submits to the association as recommended practice the accompanying drawing showing such a beam of the No. 2 and No. 2 plus capacity.

The report is signed by W. J. Bohan, Northern Pacific; C. B. Young, Chicago, Burlington and Quincy; F. M. Waring, Pennsylvania System; M. H. Haig, Atchison, Topeka &



Santa Fe; H. W. Coddington, Norfolk & Western; G. E. Smart, Canadian National, and T. L. Burton, New York Central.

Exhibit A—Recommended Prctices on Brake Brake Beam Reclamation and Repairs

The reclaiming and repairing of brake beams should be centralized at some convenient place, where there is suitable equipment for doing the work in an economical and safe manner.

General Inspection

All defective brake beams that are received at a reclaiming plant should be completely dismantled. After brake beam has been dismantled the various parts should be separated and given a general inspection. Any part of the brake beam that has any of the following defects should be scrapped: Excessive deterioration due to rusting or long life; undue wear; broken or cracked.

The following practices should not be permitted: Building up any part of the brake beam by gas or electric welding; straightening of the strut or brake head by excessive heating; any parts of brake head or strut that cannot be straightened by heating slightly should be scrapped. It is desirable to straighten struts or brake heads cold.

Detail Inspection

The various parts should be very carefully inspected in the following manner:

Brake Heads.—All heads should be gaged with A. R. A. gage shown in Fig. 1. If the center lugs are worn sufficiently to take maximum center lug *B*, or if the thickness of metal between face of center lugs and part of key slots has worn sufficiently to take the minimum gage slot *D*, or if the toes

Fig. 2—Lever Pin Hole Gage

are badly worn, the brake head should be scrapped. Brake heads with slightly worn toes can be used again. Brake heads should be free of burrs, core sand, dirt or any other foreign matter.

Struts—All struts should be gaged with lever pin hole

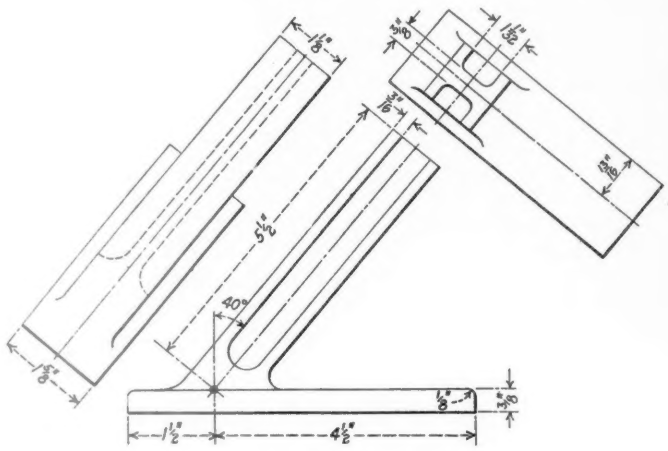


Fig. 3—Angle Gage for Strut

gage shown in Fig. 2, and if hole is badly worn so it will take the maximum end of gage it should be scrapped. Any strut having lever slot walls twisted or badly worn should be scrapped. Struts having slots set on an angle should be gaged with angle gages similar to Fig. 3.

Any strut not bearing the proper capacity of the beam it is to fit should be so marked.

Tension Rods—Any tension rod that has been flange cut, badly rusted or threads badly damaged should be scrapped. Tension rods badly bent and twisted can be straightened by heating over their entire length.

Compression Member—Any compression member that has badly worn places due to release spring or any other cause should be scrapped. Compression members badly bent or twisted should be heated uniformly throughout and then

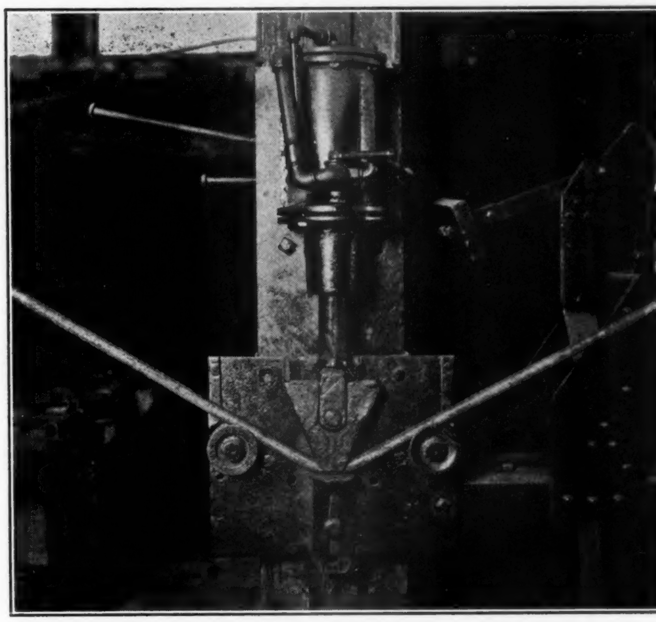


Fig. 4—Tension Rod Bending Machine

straightened. If they are only slightly bent or twisted they can be straightened without heating. All compression members should be straight before reapplying.

EQUIPMENT

The following equipment is recommended for use in connection with reclaiming brake beams:

Tension rod bending machine. Fig. 4 shows an air operated machine of this kind.

Assembling benches. Fig. 5 shows a bench of this kind now in use.

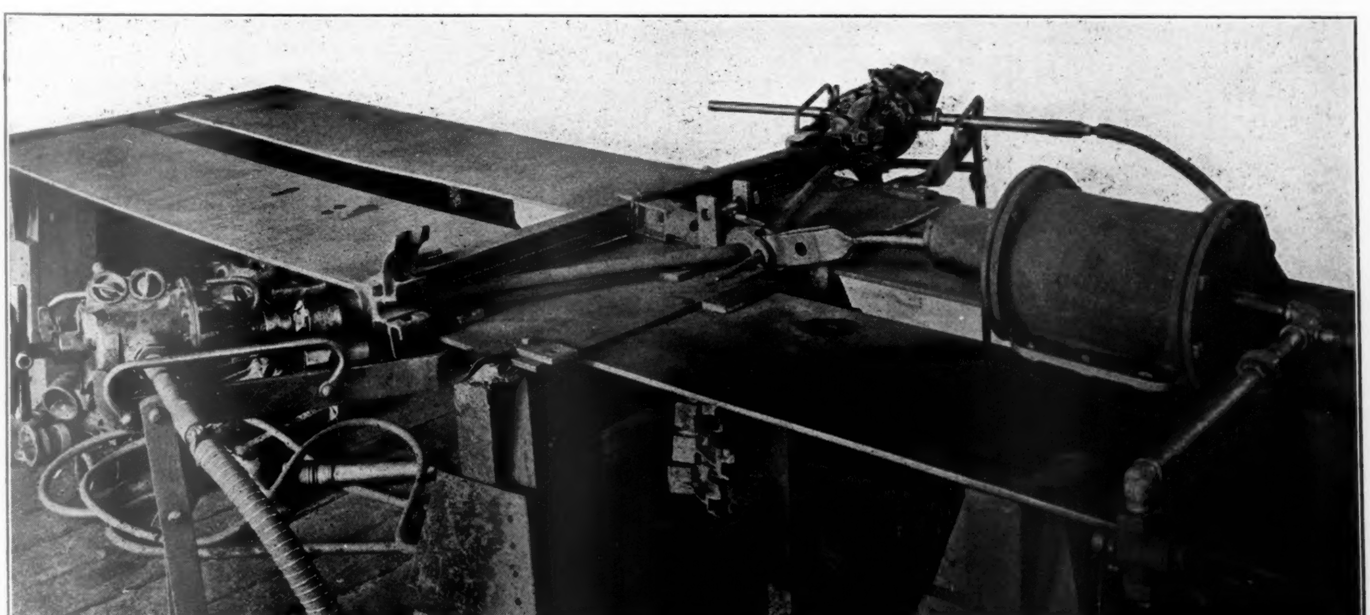


Fig. 5—Assembling Rack

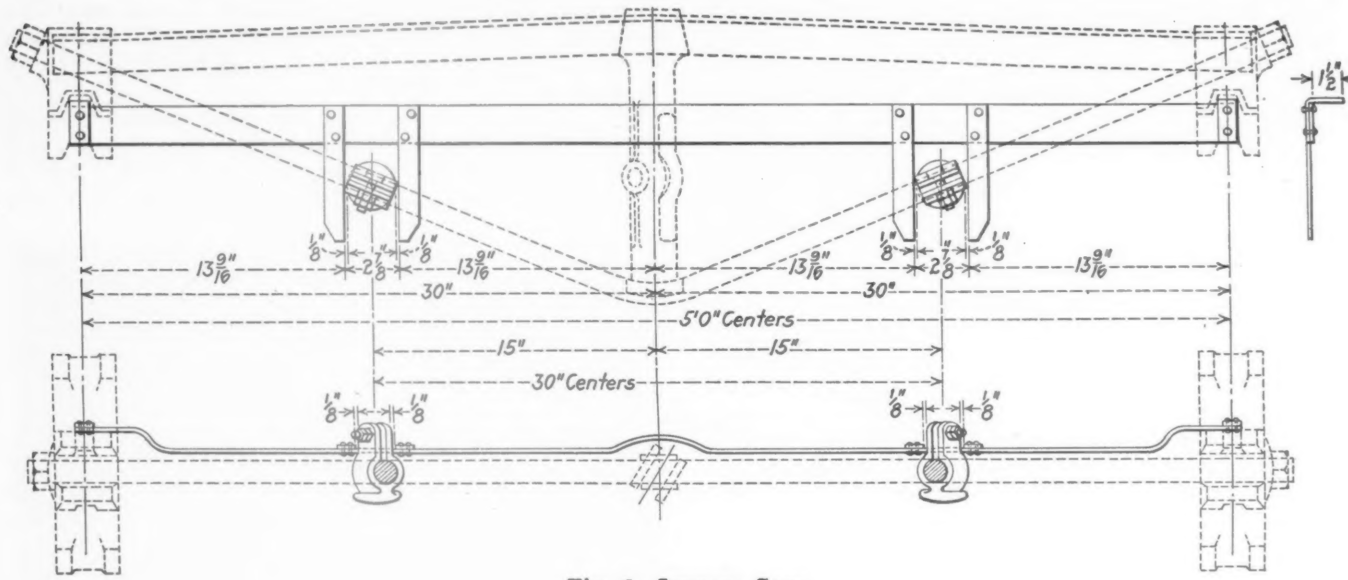


Fig. 6—Support Gage

Testing machine. Fig. 7 shows a 50,000-lb. testing machine and Fig. 8 a 75,000-lb. machine.

Suitable bins and racks for storing and caring for repair parts.

Air motor for applying nuts to ends of compression rods. Fig. 5 shows one of these motors in use.

Annealing oven.

Miscellaneous. Hammers, wrenches, etc.

Assembling and Testing

Strut should be applied to compression member and properly keyed in place.

Safety clips should then be applied.

If additional support chairs are used they should be applied next, fastening them in proper place, using a gage similar to Fig. 6.

Heads or sleeves should be placed on one end of the com-

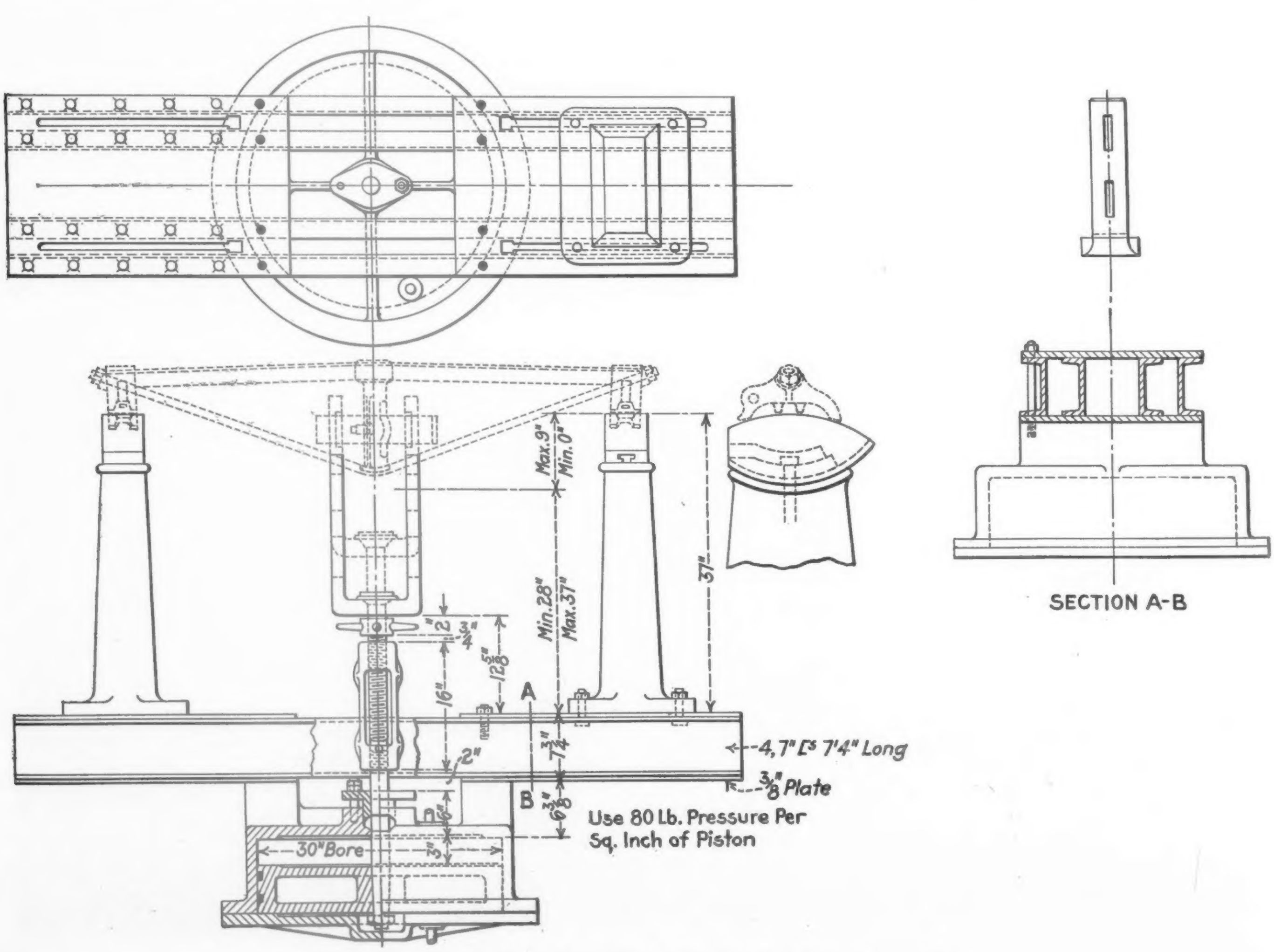
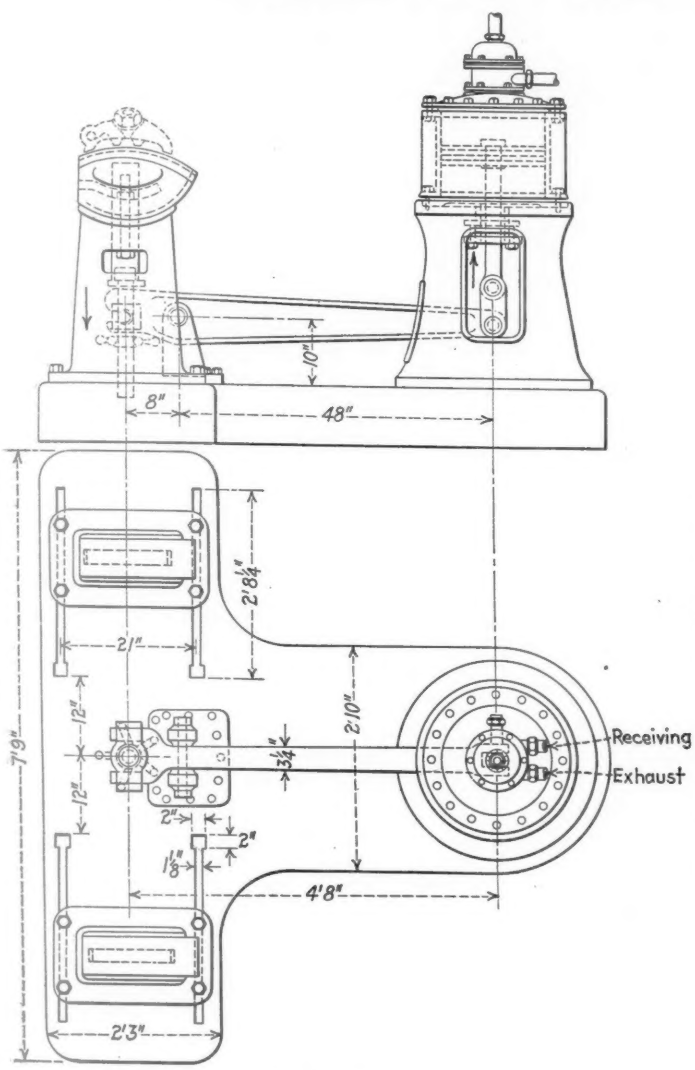


Fig. 7—Brake Beam Testing Machine, 50,000 lb. Capacity

pression member, making sure that the top is on the same side of the compression member as the head of the strut key. Some brake heads are right and left and care should be taken to see that they are properly mated. The tension rod should



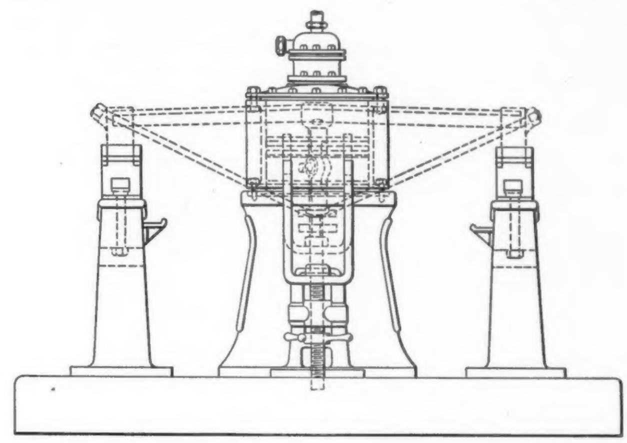


Fig. 8—Brake Beam Testing Machine, 75,000 lb. Capacity

be inserted in the head or sleeve on the compression member, laying the truss rod seat in the end of the strut, and then apply the other head or sleeve.

Nuts should be applied to the ends of the tension rods, screwing them up to a full thread. This places the beam in

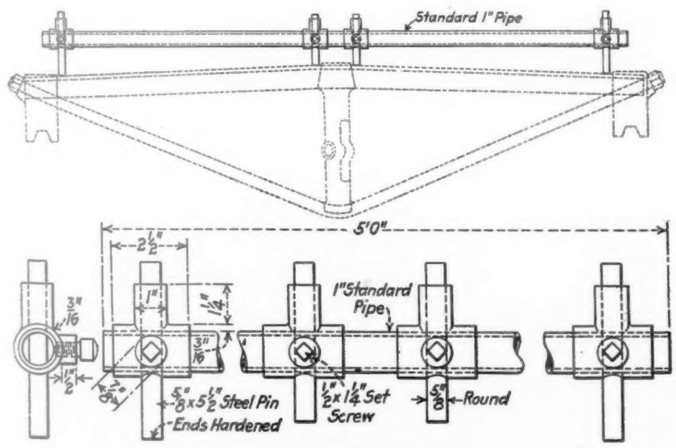


Fig. 9—Camber Gage

tension or camber. The beam should be checked for correct camber, using a gage similar to Fig. 9.

The beam should be placed in a proof testing machine similar to that shown in Figs. 7 or 8 and apply a proof load of the capacity of the beam, check and adjust the camber. After this a second proof load is to be applied, released, and the camber again checked. The truss rod nuts are adjusted until all four points of the camber gage come in contact with the back of the compression member. The ends of nuts are then riveted over about one-third of the rod circumference.

The beam should be checked for head centers with a gage similar to that shown in Fig. 10, by placing the legs of the gage in the top of the brake shoe key slot opening on the upper center head lug. If the gage goes in, the beam will meet A. R. A. head center requirements. The pin hole location should be checked with a gage similar to that shown in Fig. 11. Beams having rigid heads must be carefully checked

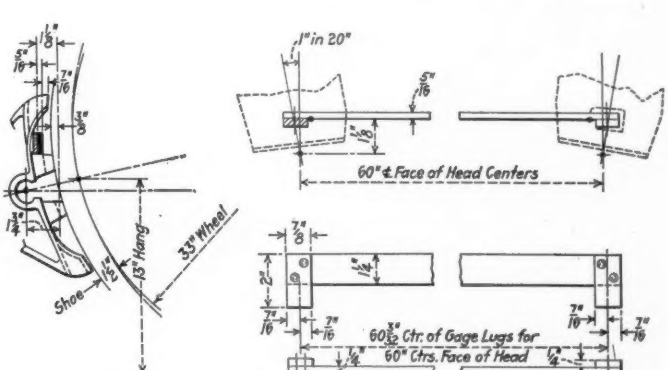


Fig. 10—Head Center Gage

to see that both heads are parallel. Fig. 12 shows a device for straightening these heads.

All beams should be well covered with quick drying metal paint.

Exhibit B—Brake Beam Head Strength Tests

No. 2, No. 2 plus and No. 3 brake beams complete with brake heads, were furnished by seven manufacturers for test purposes, a number of different styles of brake heads being represented. Tests of the brake heads of these brake beams were made in all cases by applying the load to the strut of the brake beam as under service conditions. The three conditions under which the load might come upon the brake head were considered: (1) center lugs only resting upon the support, (2) brake head cocked, so that one center lug and

one toe rested upon the support, and (3) toes resting upon the support, with center lugs free.

The test results obtained under condition (1) evidenced no set and but slight deflection at the set load called for by the brake beam. Tests under condition (2) were found to be impracticable. It was therefore concluded that test under condition (3) represented the maximum condition of weakness, and this method of supporting the brake head for test was accordingly chosen as adequately covering any possible condition that might be obtained in service.

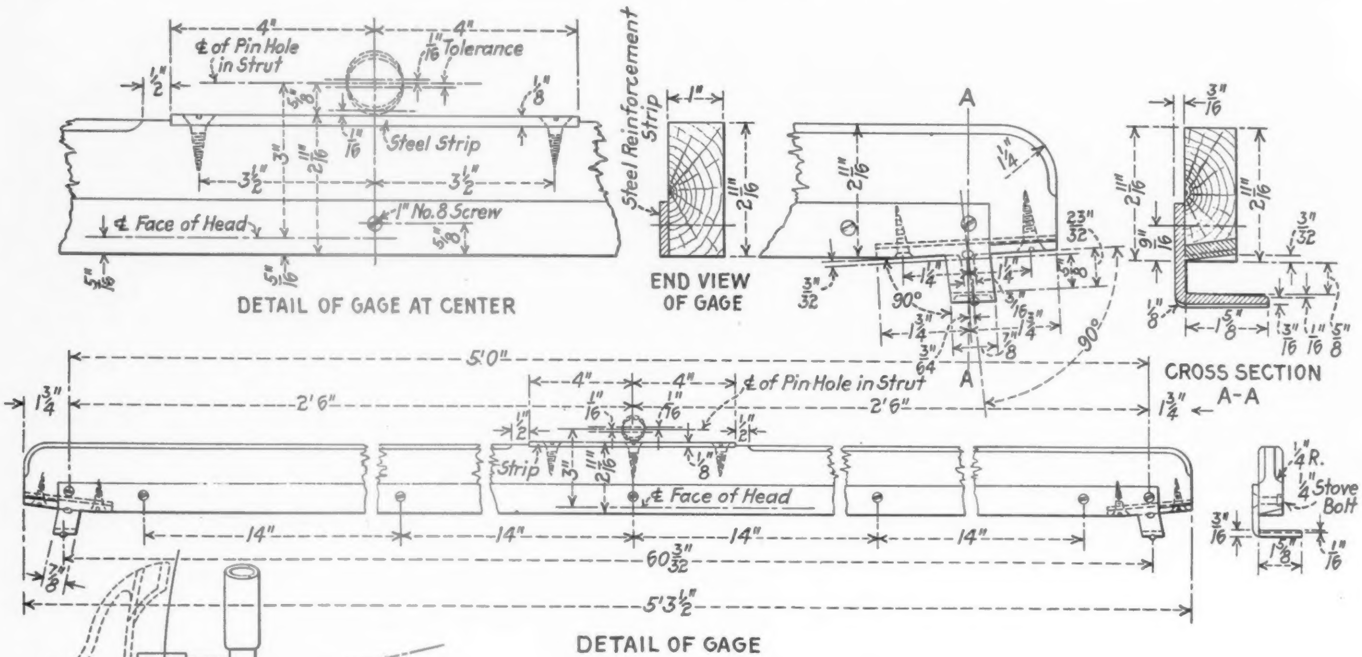
Tests in each case were accordingly made by mounting the brake beams in the testing machine with the brake heads resting upon the radius blocks illustrated in the photographs, the load being carried upon the toes of the brake head, with the center lugs clear. Deflection of the heads was measured by apparatus designed by G. E. Doke for the New York Central Laboratory, also illustrated in the photographs. The datum bar of the deflection apparatus is clamped to the toes of the brake head, one end of this bar being free to allow the device to adjust itself to longitudinal spreading movement. The recording mechanism, an Ames dial gage reading to one-thousandth of an inch, is clamped to the lower center portion of the brake head, with the movable spindle in contact with the datum bar. This apparatus is self contained, and therefore measures only the deflection within the brake head, independent of any movement between the brake head and the support.

Twenty-one brake beams of various designs were tested by the sub-committee. Readings of deflections and the permanent set obtained upon brake heads were taken at the deflection loads and set loads required by the brake beam specification for No. 2, No. 2 plus and No. 3 brake beams, in addition to which the load and permanent set occurring at 1/32 in. and 1/16 in. deflection of the brake head were also noted.

Discussion of Tests—Condition No. 3

The results obtained are not consistently uniform. Loads appreciably in excess of the specified deflection load of the brake beam frequently produce distortions and twists in the several brake beam parts, that result in readings so variable and ununiform as to be of little practical value.

In numerous cases the strength of the head is not in proportion to the capacity of the brake beam; that is, for equal loads the brake heads of brake beams of higher capacity show more deflection than heads on brake beams of lower capacity.



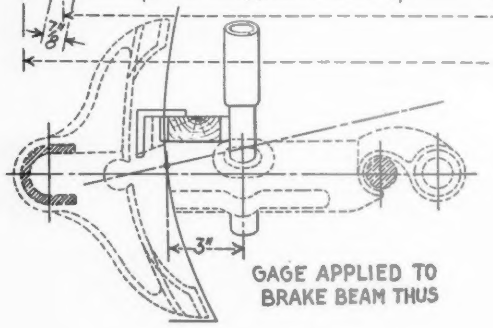


Fig. 11—Brake Beam Gage

Although as stated the results are not in all cases uniform, they indicate as a whole that the elastic limit of malleable iron brake heads of the designs tested occurs at approximately 1/32 in. deflection of the brake head.

Conclusions

Tests of brake beam heads do not appear necessary if the load in service always comes upon the center lugs. However,

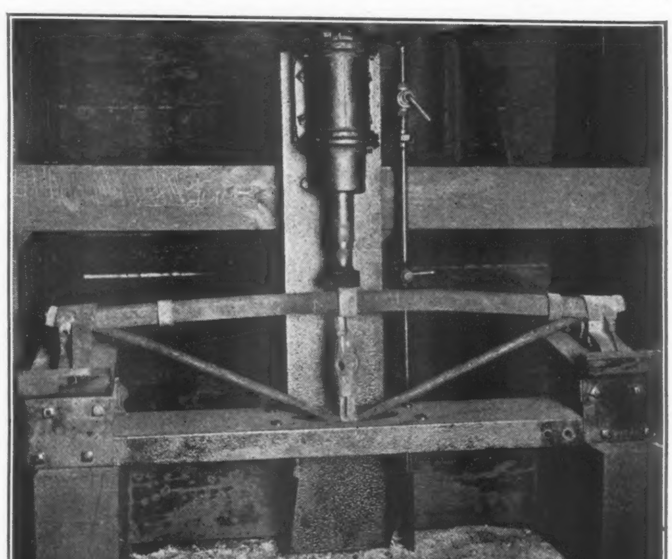


Fig. 12—Brakehead Straightening Machine

if in the opinion of the Brake Beam Committee the load is not always restricted to the center lugs, but is frequently carried principally on the toes, then a standard strength of

head and standard method of test for determining same, is desirable. The information obtained indicates that this standard of strength can apparently best be determined under the method of support (3) described above. The elastic limit of malleable iron heads indicates that this standard should be approximately as follows:

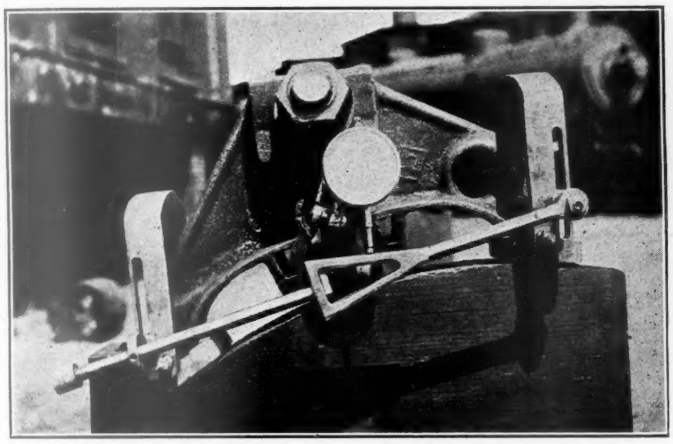
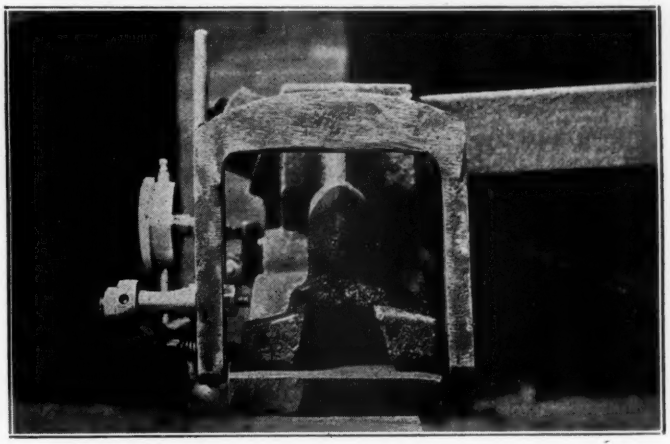
When the deflection load specified for a brake beam of given capacity is applied to the brake beam, the brake heads themselves should not show more than 1/32 in. deflection, with no permanent set.

Whether a deflection of 1/32 in. of the brake head, which would increase the present permissible deflection of the brake

G. E. Busse, chairman, Mechanical Committee of the Brake Beam Manufacturer's Institute, witnessed the above tests, representing the Brake Beam Manufacturer's Institute.

Exhibit C—Brake Shoe Key Design and Fit of Shoes, Head Faces and Key

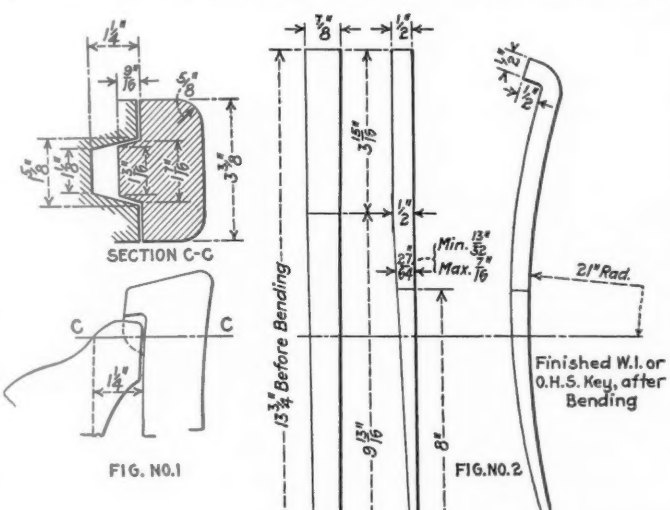
The subject of brake shoe key design and details involved in the fit of the shoe, head, face and key was investigated by F. M. Waring who advises that an examination of a large number of freight cars in yards disclosed the almost universal condition of the keys being all the way down and still a loose fit, thus indicating the advisability of a change in the

Apparatus for Measuring Brake Head Deflection

beam as a whole by that amount, would so disturb existing brake rigging standards as to make it impracticable, must necessarily be decided by the Brake Beam Committee.

It is recognized that 50 per cent or more of present day



Proposed Dimensions for Recess in Toes of Brake Head and Proposed Design of Brake Shoe Key

designs of brake heads will not meet the above requirements, but if the load is frequently carried principally upon the toes of the brake head, then the sub-committee feels that such a requirement is logical, as otherwise the specification would permit permanent set at a given load in one member of the assembled brake beam, and at the same time require that the brake beam as a whole should show no permanent set at that load.

key design. The most logical change seems to be to make the key thicker at the center than is now specified. Fig. 2 shows a new design of key that has been tried out and is suggested for consideration.

The proposed key is thinner at the point and has a somewhat greater taper than the standard key, so that it becomes ½ in. thick at a point 3 15/16 in. from the end instead of just under the head. The drawing shows a tolerance of 1/32 in. in thickness, which is a practical working limit if the key is drop forged or rolled.

A key machined to the exact dimension shown was tried with new brake heads and shoes, which were selected by gaging, so as to give the maximum and minimum opening for the brake shoe key. With the maximum opening the experimental key could be pushed in by hand until the shoulder was within ¾ in. of the brake head. With the minimum opening the key stood out about 3⅞ in.

The key was then tried on a number of new brake beams and new shoes taken from stock and on a number of brake beams on cars in repair yards.

The table shows the distance the key protruded from the brake head when applied without being hammered down. When the key protruded several inches, it was found that it could be driven down about 1 in. further.

FIT OF EXPERIMENTAL BRAKE SHOE KEY

	Number of keys	
	New brake heads and shoes	Brake heads and shoes on cars in service
Loose when forced all the way in.....	0	4
All the way in before being tight......	0	55
Projecting from 0 in. to 1 in., inclusive.	0	2
Projecting from 1 in. to 2 in., inclusive.	0	8
Projecting from 2 in. to 3 in., inclusive.	13	9
Projecting from 3 in. to 4 in., inclusive.	7	8
Projecting from 4 in. to 5 in., inclusive.	0	7
Projecting from 5 in. to 6 in., inclusive.	0	2
Total	20	95

These figures show the desirability of a thicker key and

they also show that it will be difficult to get a key that will fit old parts as well as new parts. However, the proposed key should be an improvement over the present standard and there will be only a few cases when it will be too large to be used. It is evident from experiments with brake heads or shoes which have been gaged that where the key projected over 4 in. from the brake head, the brake shoe or head is not within the limits of the standard gages.

When trying the proposed key on cars in service, the old keys removed were measured at a point 5⅜ in. from the head. Taking the measurements at a uniform place did not always show the greatest wear. However, 63 per cent of all old keys were only 5/16 in. or less. It would appear that a good deal could be accomplished in keeping the brake shoes tight by putting in a limit on the thickness of key which should be allowed to remain in service. We therefore suggest for consideration a limiting thickness of ⅜ in. at any place within 5⅜ in. of the shoulder.

Report of Committee on Tank Cars

During the past year the work of the committee has been mainly the continuation of its efforts to secure improvement in certain details of construction, principally the safety valve, bottom discharge valve, dome closure arrangement and anchorage of tank to underframe. In this work the Committee has had the benefit of the co-operation of the Bureau of Explosives, American Petroleum Institute and the National Petroleum Association.

Safety Valves

Additional tests have been made at Altoona of the experimental designs submitted by manufacturers of locomotive safety valves, which had been modified as the result of the tests referred to in the 1920 report; and also of other modifications of the standard design, including changes in the dimensions of the valve disks, non-corrosive seats, etc. The committee can only report progress for the reason that no valve has proved absolutely tight at pressures at or near the popping point (25 lb.). Observation of the leakage prior to popping has shown that the escape is always on one side, indicating a tendency of the valve disk to cock. Special guides have been tried and special springs have been made in an effort to secure true closure, but so far without success.

Some of the valve manufacturers are willing to make other modifications, but before asking them to do this the committee is endeavoring to get from the oil trade some definite information as to the extent of the losses which can be properly charged to the safety valve. The available data indicates that with straight refinery products the losses are not large; also that with insulated tank cars the loss with casinghead blends is slight, but the question of safety valve leakage assumes importance because the uninsulated car may carry very volatile products, some of which are constantly under pressure.

The tests have shown conclusively the large discharge capacity of the standard valve—about 31,000 lb., equal to 4,800 gallons of gasoline per hour—so that an 8,000-gallon tank with its two safety valves would be discharged in about 50 minutes with very little rise in the pressure. One of the experimental valves gave a discharge capacity of 40,000 lb. per hour.

The committee has approved some slight modifications in the details of the design of the valve to reduce foundry losses and to facilitate machinery. These changes do not affect the functioning of the valve, or the interchangeability of the parts, and the committee recommends that they be incorporated in the standard design of valve.

Bottom Discharge Valves.

This question has been assigned to a sub-committee of which J. E. Grant, special agent of the Bureau of Explosives, is chairman. This sub-committee is working in close co-operation with a similar committee of the American Petroleum Institute. There have been about twenty-five designs submitted, eleven of which are being tried out under observation in service. It is hoped that another year will demonstrate the correct principles on which satisfactory designs must be based.

Reports show that a large part of the unsatisfactory performance of existing valves is due to failure to keep the tanks and consequently the valve seat clean.

Extensions to Bottom Discharge Outlet

There have been a number of protests against the requirement adopted last year that:

> No nipples, valves or other attachments shall project below the bottom outlet cap, except while car is being unloaded.

These protests emphasize the lack of confidence in the present bottom outlet valves, in that it is claimed that the cocks attached to the bottom cap are necessary to enable the consignee to tell whether the outlet valve is closed, and that if the valve is not properly closed the removal of the cap would permit the uncontrollable discharge and loss of the contents of the tank. The trouble is really due to man failure rather than design failure. The regulations of the Interstate Commerce Commission require that the bottom cap shall be removed when the tank is loaded, and if this is done it will insure the valve being properly closed and there will be very little danger of its being unseated in transit. The one exception is where water from gasoline leaks past the valve into the outlet pipe and freezes, which may result in unseating the valve or breaking the outlet pipe, or both. The overcoming of this is one of the features of the problem of a satisfactory valve.

The committee believes a further step should be taken to guard against the danger of breakage of the outlet pipe by limiting the distance which the outlet projects below the sills to that required to operate a wrench in applying and removing the cap. It is, therefore, recommended that:

> Effective July 1, 1922, in the case of new cars and of replacements on existing cars, the bottom outlet pipe when applied to tanks of cars having center sills shall not project below the bottom line of sills more than the threaded length necessary to permit the application and removal of the bottom outlet cap.

The presence of a cock on the bottom of the discharge pipe is not necessarily objectionable, provided it complies with the proposed requirement.

[In connection with the bottom outlet, the committee also recommended the elimination of the following sentence from Section 7 (c), first paragraph, of Classes III and IV specifications: "Additional attachments thereto, having threads of other dimensions may be used."—Editor.]

Dome Closure Arrangement

The Bureau of Explosives takes strong ground against the ordinary screw type of dome cover, particularly for cars carrying liquid normally under pressure. It was expected that the escape of gas through the vent holes at the top of the screw portion of the cover would give adequate warning to a man of ordinary intelligence that internal pressure existed and that the dome cover should not be removed until this pressure had been relieved. The numerous casualties which have occurred because of the removal of the cover in spite of this warning show that a better form of cover is necessary.

There are also appreciable losses of contents in the form of gas due to lack of tightness of the screw cover, even where soft gaskets are used.

With cars assigned permanently to these very volatile products it would suffice to provide only such cars with another form of cover, but in an emergency, at least, any car may be loaded with these products.

The attention of the car builders has been called to the matter and a number of them are endeavoring to work out satisfactory designs. Two general types meet the requirements, viz.: (1) An internal cover supported by a screw and yoke against an inturned flange of the dome ring. Such a cover can not be removed while there is internal pressure. (2) An external cover held in place by a number of hinged bolts, the nuts of which engage lugs on the cover so designed that the cover can not be removed as long as there is internal pressure against it.

It may be necessary, eventually, to require that all new cars shall be equipped with some form of cover which can not be removed until internal pressure is relieved. The committee believes that a beginning should be made with cars carrying casinghead gasoline and its blends, and recommends that paragraph 6 (c) of the Class IV Specification be amended to read:

For cars built after July 1, 1922, the dome cover, if external, shall be secured by bolts; or if internal, by yoke and screw.

The Committee feels that the external cover is preferable because of the greater probability of good workmanship and because its operation is simpler.

Anchorages.

The center anchorage for tank cars is the subject of a basic patent which expires in August, 1921. Because of this patent builders have been allowed considerable latitude in their designs of this type of anchorage. Some of these designs have proved unsatisfactory in service, and a number of cases have been reported of tanks going adrift with breakage of outlet pipe and loss of contents. So far these failures have been confined to the bolted anchorage and are traceable to bad design or workmanship, or both. The principal causes have been the use of rough bolts in unreamed holes instead of turned bolts in reamed holes, as required by the specifications; and the use of wooden fillers, prohibited by the specifications, between the anchorage and the underframe, so that the bolts are in flexure instead of in shear. In a number of cases the bolts were threaded so far down that the shearing value was that of the root of the thread instead of the body of the bolt, while the bearing value was but that of the top of the threads.

This matter was taken up with all of the tank car builders, and where it was found desirable to change the designs it was willingly done. The approved designs of all of the builders now provide connections materially in excess of the minimum requirements of the specification and it is believed that no failures of these anchorages will result with any reasonable handling.

Heater Pipes

The Committee can only report progress upon this subject.

Number and Class of Tank Cars

The growth in the number of tank cars is shown by a recent tabulation from Boyd's Tank Car Circular, which shows a total of about 137,000 tank cars in service, of which 125,500 were of private ownership and 13,500 of railroad ownership. This compares with figures for January 1, 1913, given in one of the Interstate Commerce Commission reports, viz.: 30,039 of private ownership and 9,150 of railroad ownership, a total of 39,189.

Welding

In its 1912 report the committee called attention to the desirability of the welded tank, and in 1919 provision was made in the specification to permit the experimental use of welded tanks for Class III cars. Several welding concerns have given the question attention, but so far the cost of tanks welded by the forge welding process has been so high as to be prohibitive. Recently one of the large pipe manufacturing concerns proposed the use of its forge welded pipe for this purpose. If this proposition assumes definite form your committee will be prepared to take up the question of this construction as an alternative to the riveted tank.

Various overtures have been made to permit the use of autogenously welded tanks, but the committee is not prepared to recommend the acceptance of such tanks in advance of definite proof of the reliability of this method of welding. At present there are too many uncertainties as to the character of the welds made by different operators, and particularly as to the ability of such welds to stand the alternating bending stress to which tank cars are subject.

The one exception which has been made is in the case of anchorages on welded Class V tanks. It was originally required that this should be forge welded, and during the War a number of tanks for the United States Government were so welded but the results were unsatisfactory. Owing to the nature of the lading, exposed anchorage rivets are objectionable and the latest construction approved by the committee consists of riveted anchorages with the rivet heads on the inside covered by autogenously welded cup shields.

In this connection the attention of the committee has been called to the fact that in some cases cracked shells have been repaired by autogenous welding and that the result has not been satisfactory. The committee recommends that, for the present at least, repairs to shells of tanks shall not be made by autogenous welding.

A. R. A. Standards and Recommended Practice

The specifications for Classes III, IV and V tank cars, under the head of Couplers, Brakes and Trucks, prescribe "A. R. A. Standards and Recommended Practice." It has developed that this, in connection with the Rules of Interchange, makes the standards and recommended practice mandatory in the case of tank cars where they are not so in the case of freight cars generally. It was not the intention of the committee to single out tank cars for greater compliance with the standards and recommended practice than is required in the case of other kinds of freight cars, and the committee recommends amending this requirement to read:

A. R. A. Standards and Recommended Practice as in the case of other classes of freight equipment cars.

Brakes

Question has been raised as to the difference in the wording of the brake requirements for Classes I and II cars, reading:

Each car shall be equipped with air brakes of a capacity equal to not less than 70 per cent of the light weight of car, and at least one hand brake operating the brakes of both trucks.

and those for later classes of cars, reading:

A. R. A. Standards and Recommended Practice.

When the general revision of the specification was made in 1916 the committee, in accordance with its policy of avoiding as far as possible retroactive requirements, did not recommend any change in this respect so far as Classes I and II, which were the existing cars, were concerned. The difference is more in form than in substance, the original 70 per cent brake power being based on 60 lb., the pressure due to emergency application, while the 60 per cent is based on the 50 lb. due to equalized service application. As there is so

little difference in the final results it is believed that the situation can be satisfactorily covered by adding, in the case of Classes I and II cars:

When any change is made in the brake arrangement it shall be made to conform to A. R. A. Standards and Recommended Practice.

Tank Cars for Hydrochloric Acid.

Certain products such as hydrochloric acid, vinegar, etc., because of their chemical reaction can not be successfully handled in the ordinary metallic containers. In the case of hydrochloric acid, which is extremely corrosive, it has been handled in wooden tanks mounted on flat cars. The committee has not, so far, recommended any specification for such cars, but, at the suggestion of the Bureau of Explosives, in view of complaints as to leakage with existing designs of cars, the question of developing a standard specification has been taken up and a sub-committee of five representatives of the largest acid shippers in co-operation with the Bureau of Explosives is engaged in experiments with steel and wooden tanks with glass and rubber linings, and with wooden tanks enclosed in steel shells insulated by plastic bituminous materials.

The report is signed by A. W. Gibbs, chairman, Pennsylvania System; C. E. Chambers, Central Railroad of New Jersey; S. Lynn, Pittsburgh and Lake Erie; John Purcell, Atchison, Topeka & Santa Fe; George McCormick, Southern Pacific; F. K. Tutt, Missouri, Kansas & Texas; Col. B. W. Dunn, Bureau of Explosives; A. E. Smith, Union Tank Car Company; Geo. Hartley, Semet Solvay Company, and C. W. Owsley, The Texas Company.

Report on Train Brake and Signal Equipment

Retaining Valves for Freight Equipment

The question of retaining valves for freight equipment cars referred to in this committee's report of last year has been made the subject of a special investigation by a sub-committee, which outlined and arranged for a series of tests on grades ranging from 1½ to 3½ per cent, with retaining valves of various capacities. Owing to the serious business depression now generally prevailing, the tests were discontinued before sufficient information had been collected to permit the committee making definite recommendations.

Automatic Hose Connections for Freight and Passenger Equipment

The question of automatic hose connectors for freight and passenger equipment was referred to a sub-committee which reports that there were thirty-nine answers to the circular of inquiry sent out February 20, 1920, to all of the railroads in the United States; four railroads reporting experience with automatic connectors. Of these, there is only one which has any considerable number of cars equipped, or which are in any representative service. The committee learned that there were some automatic connectors used in Canada, which were not included in the answers to the circular, and endeavored to find what information could be obtained from this trial; but was unable to get any great amount of information.

The committee is unable to find in the reports a design that would seem to lend itself to general use, and for the lack of such information is, therefore, unable to make any specific recommendations at this time.

Air Brake Cylinder Packing

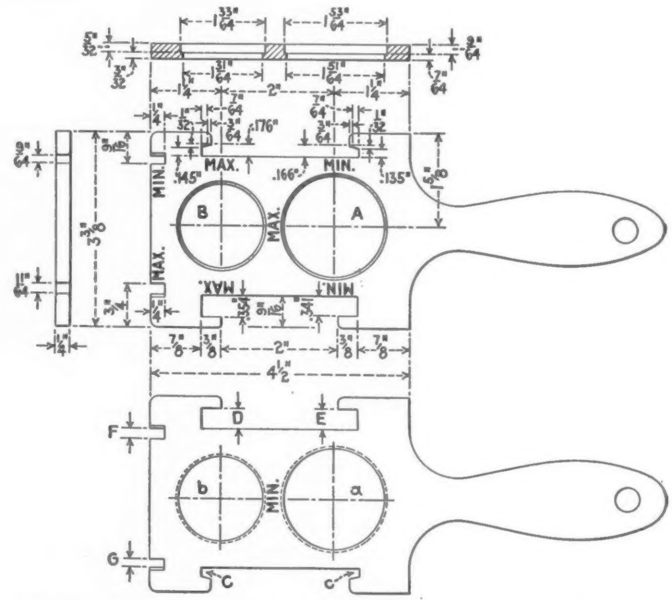
The committee has further considered the matter of air brake cylinder packing made of leather substitutes. It has also been recently suggested that specifications be prepared for brake cylinder packing. The committee will solicit the assistance and co-operation of the Committee on Specifications and Tests for Materials in preparing suitable specifications, after which it will be in position to submit definite recommendations.

Mechanical Sanders

The committee has considered the question of connecting mechanical sanders to the engineer's brake valve in a manner that will automatically sand the rails when the brake valve is placed in emergency position. This is a local matter and the committee has no recommendations to make.

Life of Air Brake Hose

This subject has been investigated by a sub-committee which has reviewed all data available. Unless the period for removal of air hose in service is extended to at least thirty months a large number of hose will be removed which would last for a much longer time; also the fixing of such a period for removal from service would not provide for removing a large number of hose which fail within this period. Instead of establishing a maximum life it would be preferable to consider revising the present specifications to provide a better quality of hose, and it is suggested that



Openings "A" and "a" are for gaging max. and min. (external) diameter of packing ring flange.
Openings "B" and "b" are for gaging max. and min. (external) diameter of projecting wall or face portion of ring.
Slots "C" and "c" are for gaging max. and min. thickness of flange and bevel on surface of flange.
Slots "D" and "E" are for gaging max. and min. over all depth of ring at face.
Slots "F" and "G" are for gaging max. and min. thickness of projecting wall or face portion of ring.
Rings must enter all sections of gage marked "max." and must not enter any section of gage marked "min."

Fig. 1—Tolerance Gage for Air Hose Coupling Packing Rings

this be considered by the Committee on Specifications and Tests for Materials.

The committee again calls attention to the importance of applying the soap suds test as called for in the present rules governing the maintenance of freight brakes.

Extra Heavy Pipe and Nipples for Air Brake Train Line

A member has requested that consideration be given to

using extra heavy wrought iron pipe and nipples exclusively for repairs to all freight car equipment, regardless of age, and that prices for material be revised accordingly. This practice is in effect on several large roads and while extra heavy wrought iron pipe is unquestionably superior to steel or standard weight pipe, in view of the decided difference in first cost the committee does not feel justified in recommending a change at this time. It is suggested, however, that standard weight nipples be used at the angle cock with either extra heavy or standard weight brake pipe.

Location of Angle Cocks on Locomotives

In view of the fact that this subject was investigated during the period of Federal Control by the Railroad Administration's Committee on Standards, assisted by several members of your Committee on Train Brake and Signal Equipment, without being able to develop a solution for the problem, the committee is not now in position to develop anything new on the subject.

Gages for Air Brake Hose Couplings and Packing Rings

The Committee on Specifications and Tests for Materials has recommended that, (*a*) suitable gages be developed for checking the dimensions of hose couplings when new, (*b*) consideration be given to changing the form of present standard gage for hose coupling packing rings, and (*c*) the tolerance dimensions for packing rings be made to conform to the tolerances shown in its report for 1919, which was printed in Circular S III-23.

With one exception the tolerance dimensions referred to are practically the same as are now provided for in the standard gage for hose coupling packing rings, the exception being that the gage provides for no tolerance in thickness of packing ring flange. The Committee on Train Brake and Signal Equipment now believes it desirable to provide for tolerances for all dimensions, and recommends that the gage drawing be revised to conform to the accompanying Fig. 1.

It is suggested that the question of gages for hose couplings be made the subject of investigation by this or a similar committee during the coming year. The Committee on Specifications and Tests for Materials concurs in this suggestion and has consented to furnish a sub-committee, if necessary, to assist in such an investigation.

Adjustment of Hand Brake Power on Freight Cars

On account of the present business depression in railroad service, the test which was scheduled to be made early this spring in connection with the adjustment of hand brake power on freight cars has, with the approval of the General Committee, been indefinitely postponed.

The report is signed by T. L. Burton (Chairman), New York Central; B. P. Flory, New York, Ontario & Western; J. M. Henry, Pennsylvania System; L. P. Streeter, Illinois Central; R. B. Rasbridge, Philadelphia & Reading; G. H. Wood, Atchison, Topeka & Santa Fe; H. M. Curry, Northern Pacific; W. J. Hatch, Canadian Pacific, and G. C. Bishop, Long Island.

The Use of Powdered Fuel Under Steam Boilers

Summary of Present Installations; Results of Tests; Information Obtained from Operation

A VERY complete summary of the developments which have been made in the use of powdered fuel under stationary boilers was given in a paper presented by H. D. Savage of the Combustion Engineering Corporation, New York, before the American Iron & Steel Institute at its last meeting.

The primary object of the paper was to give a digest of the work that has been done in the last three years in equipping steam power plants for burning powdered coal, to record the progress in making the use of powdered coal for steam production reliable and efficient and to present the economic possibilities of this method of combustion.

Preparation and Handling Equipment

Two mills, known as the Raymond and the Fuller have become practically the standard for pulverizing. Each of these mills is built in sizes of from 2 to 6 tons an hour rated capacity when grinding to a fineness so that 95 per cent will pass 100 mesh and 82 per cent through 200 mesh and using bituminous coal containing less than 1 per cent of moisture. The power consumption is from 15 to 20 hp. per ton per hour of bituminous coal ground to above specifications. The maintenance will approximate 5 cents a ton when grinding bituminous coal and much higher when grinding anthracite. Tube mills or ball mills, generally employed in the early days for this work, have been gradually replaced. A new mill is being developed at the present time employing air separation but otherwise differing entirely in type and principle from any of the present standard methods.

There are two types of dryers, the single-shell and the double-shell. The latter has several advantages, such as larger capacity, better efficiency and greater freedom from internal fires. The first cost is not greatly different for either of the two types. The most widely used method of transporting coal from the pulverizing plant to the boiler bins is the screw conveyor, but air transport systems are at the moment meeting with much popular favor. Of these systems the Fuller-Kinyon pump is probably the simplest. It is essentially a high-pressure feeder, consisting of a hopper, high-speed screw and a delivery nozzle. Air is brought into the coal at about 40 lb. pressure and forced through pipes of varying sizes, depending on the capacity for which the pump is designed.

Typical Installations

The first commercial installation of any considerable size was at the Oneida Street plant of the Milwaukee Electric Railway and Light Company, at Milwaukee, where five Edge Moor boilers, each of 468 nominal horse-power capacity, were equipped in 1918. This plant, which is a combined heating and power plant, has been in operation for nearly three years with no unusual operating difficulties and with no interruptions to service due to powdered coal operation.

At the plant of the Allegheny Steel Company, Brackenridge, Pa., there are equipped nine 333 hp. Wickes boilers and two 600 hp. Stirling boilers. The boilers have been in operation for about two and one-half years, and have met all requirements of a widely fluctuating load, which is characteristic of steel plant operation, with large fuel and labor savings. Additional boilers are now being installed. An unusual feature of this installation is the fact that no dryers are used. The company mines its own coal adjacent to the plant and the coal contains less than one per cent moisture as it comes from the mine. The pulverizing plant is approximately 350 ft. from the boiler room and although the screw

conveyor used to transport the coal is exposed to the elements no difficulties have been met with due to lack of dryers.

The Lima Locomotive Works, Lima, Ohio, have equipped six 400 hp. Wickes boilers, one 500 hp. Heine boiler and one 500 hp. waste heat Wickes boiler.

At the Oklahoma City plant of Morris and Company, there are five 500 hp. Edge Moor boilers and two 300 hp. Edge Moor boilers. A distinguishing feature is the ability to operate on either natural gas, fuel oil, or powdered coal—whichever the condition of the market warrants as being most economical. A change from one fuel to another can be made in about five minutes.

The St. Joseph Lead Company, Rivermines, Missouri, has equipped two Stirling boilers of 768 hp. each which have now been in operation for a few months. They are being operated at from 200 to 225 per cent of rating, with flue gas temperatures of 580 deg. to 609 deg. F. The new Lakeside plant of the Milwaukee Electric Railway and Light Company has eight 1,308 hp. Edge Moor boilers, two equipped with the Fuller system and six with the Lopulco system.

Another interesting application just now nearing completion, is at the River Rouge plant of the Ford Motor Company, where powdered coal is being installed in connection with four Ladd boilers of 2,640 nominal horsepower each. These Ladd boilers are the largest that have as yet been built and are intended to operate normally at from 200 to 250 per cent of rated capacity. The boilers will operate on a combination of blast furnace gas and powdered coal and the design is such that these fuels can be used either separately or in combination, as conditions require. In this installation, the gas is introduced horizontally at a lower level than the coal and through the medium of an especially designed grid burner. Another installation is at the plant of the Bethlehem Steel Company, Lebanon, Pa., where four 520 hp. Babcock and Wilcox boilers have been in operation approximately one year. These boilers are operated at around 175 per cent. The British Columbia Sugar Refining Company at Vancouver have equipped two 504 Badenhausen boilers, two 250 hp. Babcock & Wilcox, nine 110 hp. horizontal return tubular and two 500 hp. Stirling boilers. It is understood these are being operated at around 150 per cent of rating. The Puget Sound Traction Company at Seattle, Wash., have ten Babcock & Wilcox boilers from 300 to 600 hp. which have been in operation about two years. The plants mentioned are, we believe, the only ones of any considerable size that are in actual commercial operation, although of course, a number of small isolated boilers and some waste heat boilers are in operation in connection with powdered coal.

Tests and Operating Results

Included in the paper are many tabulations of the results of various tests which have been conducted at the different plants mentioned. Some of these tests were conducted by engineers of the local plants, some by the U. S. Bureau of Mines and others by the Combustion Engineering Corporation. As the plants are located at widely separated points they naturally operate on a wide range of fuels and under very different operative conditions. The test reports and the operative figures would indicate that the results obtained are very generally satisfactory. From these tests important information was obtained in regard to the effect of fineness and the amount of moisture in the coal.

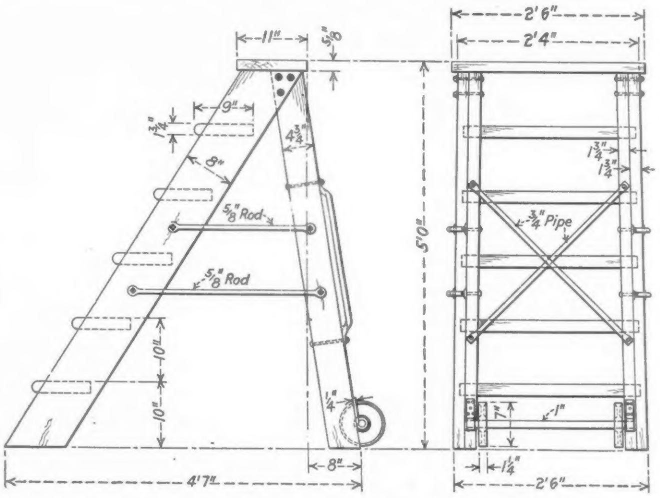
Other Factors

Additional points taken up in the paper include the design and construction of furnaces, burners and feeders; the advantages and disadvantages of firing direct from the pulverizer; the costs of installation; slagging, deterioration of brick work and ash disposal; also a comparison of operating costs between stoker equipped plants and these arranged to burn powdered coal.

Step Ladder for Car Shops

BY AUSTIN G. JOHNSON
Mechanical Engineer, Duluth & Iron Range

Step ladders for use in car shops should be strongly constructed with the legs spread well apart in both directions to make them as stable as possible. It is difficult to meet these requirements without increasing the weight of the ladder so much that one man cannot handle it. This difficulty has been overcome in the design used in the shops of the Duluth



A Ladder Which Can Easily Be Moved by One Man

& Iron Range, which is shown in the drawing. The feature of the ladder is the pair of wheels placed on the back legs. These wheels are off the floor when the ladder is in use, but when it is to be moved the ladder is tipped back so that the wheels come in contact with the floor. In this position the ladder can be handled like a wheelbarrow and one man can easily move it from place to place.

Boiler Ruptures With Man in Firebox

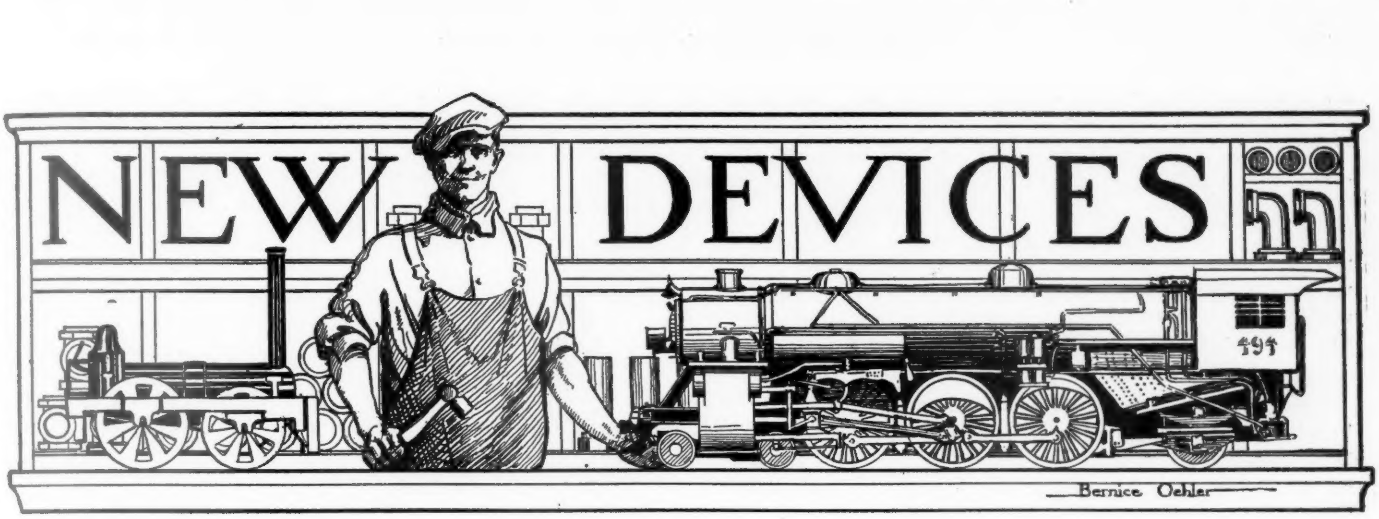
Here is a real freak story—the case of a boiler that "went up" while an inspector was going peacefully about his work in the firebox, and with no pressure up.

The boiler was of the stationary locomotive type and had been out of service a long time. At the time of the explosion the inspector was inside the firebox searching for defects, and he certainly found one. He was naturally rather startled to hear a report like the discharge of a cannon and at first thought that a stick of dynamite had exploded. He found, however, that a furnace sheet had ripped open for a length of about 36 in. directly through a weld that had been made in the sheet. The rupture extended about equal distances on either side of the part built up by welding.

The explanation of this peculiar occurrence is thought to be that the sheet had been overheated in the welding process, crystallized, and was therefore under a severe shrinkage strain. The defective part was practically free of scale. The handhole plates at the bottom of the boiler were off, but the manhole plate had been replaced.

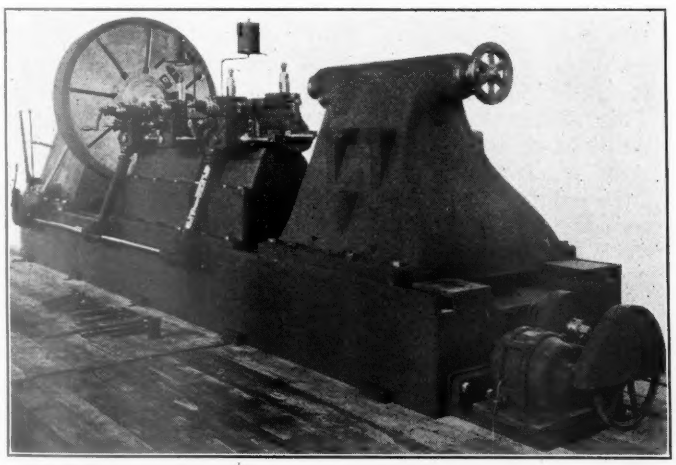
According to the inspector the condition represented by this boiler, so strikingly demonstrated in this case, may have resulted in some disastrous explosions that have occurred, the causes of which have never been determined. The incident is certainly a forceful demonstration of the dangerous stresses that may result from improper heating in the welding process.

This is an authentic report published in *Power* of an occurrence at the plant of the Calco Company, Bound Brook, N. J., where the two boilers were examined by an inspector of the Fidelity and Casualty Company for the Standard Bitulithic Company, who contemplated their purchase.



Adaptable 90-In. Journal-Turning Lathe

In view of the unavoidably high cost of heavy machine tools it is essential that they be used as large a proportion of the time as possible and this object is the more easily accomplished the greater the number of operations that can be performed on one machine. Adaptability is a valuable feature of the new 90-in. locomotive journal-lathe made by the Niles-Bement-Pond Company, New York. The machine



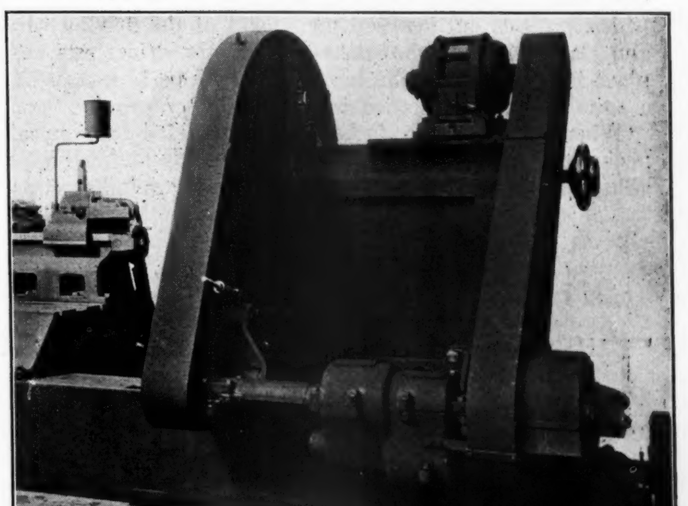
General View of Niles-Bement-Pond 90-In. Journal-Lathe

has a swing of 90 in. to take the largest driving wheels and can be used to turn either driving or trailer wheel journals with the wheels mounted. Provision is also made to turn crank-pins in place or to bore crank-pin fits in wheel centers.

The machine in general consists of a bed on which is mounted a headstock, tailstock and carriages, and to facilitate getting the work into the machine, both the headstock and tailstock are adjustable along the bed. The machine is arranged to turn two inside journals at one time, or one outside trailer journal, it being necessary to reverse the wheels when the opposite trailer journal is being turned.

The machine is driven by a 15-hp. motor, mounted on the headstock and carried on slide rails. Drive from the motor passes through the medium of a belt to a back shaft carried in ring oiling bearings, mounted on the back of the headstock. The jackshaft drives through a speed box but at high speed the drive is directly through the jackshaft. By means of a positive tooth clutch and through sliding gears in the speed box, three other changes of speed are obtained. The pulley on the jackshaft is provided with a friction clutch which eliminates the necessity of stopping the motor when changing speeds. On the forward end of the jackshaft is carried a pulley from which power is transmitted by a belt running directly around the face-plate. A tightener pulley is supplied for this belt and is held up to engagement with the belt through the medium of a compression spring. This double belt drive as described performs a valuable function in tending to eliminate chatter and tool marks on the turned journals. Suitable sheet iron or woven guards protect the belt leading from the motor to the jackshaft, as well as the belt leading from the jackshaft to the face-plate. A 6-in. belt is used to drive from the motor to the jackshaft and a 6-in. belt from the jackshaft to the face-plate. The face-plate speeds obtainable are from 20 to 60 r.p.m.

The levers for controlling the friction clutch and speed changes are brought to the front of the machine within easy reach of the operator. The face-plate revolves on a stationary spindle member, and with this construction the headstock center is a dead center. The tailstock is of the type usually furnished on large engine lathes and merely supports the



Rear View Showing Method of Driving

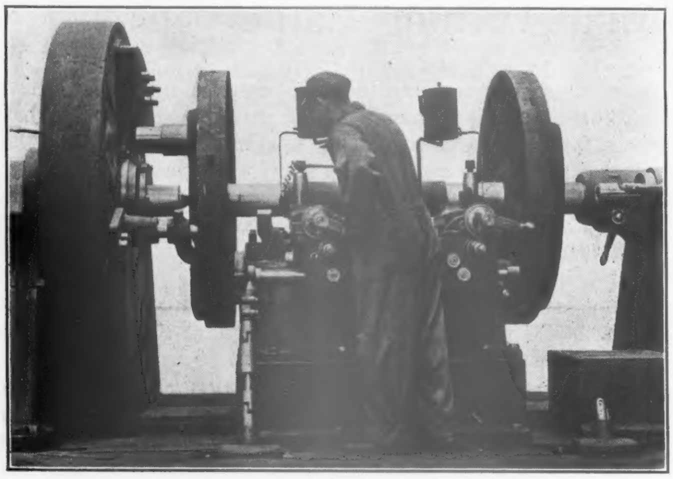
work on an adjustable spindle which is arranged to be clamped.

The carriage details consist of a large base, located in a fixed position between the driving wheels. On this base are mounted two sets of carriage rests and tool slides for turning simultaneously two inside journals, up to 22 in. long. The tool rests have power longitudinal feeds and power cross feed for facing hub liners. For turning outside journals a

separate rest is provided which is mounted on a base adjacent to the tailstock.

The feed is driven from a gear whose teeth are cut directly in a steel bushing member carried in the face-plate. This gear engages a gear carried on a shaft brought up to the front of the headstock, and from this shaft, through a medium of bevel gears and a diagonal shaft, feed is transmitted through a feed box where feed variation is obtainable, and from the head through a spline shaft extending along the front of the bed. From this shaft power is transmitted for either the inside or the outside journal turning operations.

Provision is made so that hub liners may be faced by either hand or power feed. The journal turning operations also have both power and hand feed. The carriage detail parts are arranged so that burnishing tools may be used for either the inside or outside journals. For turning driving axles, an attachment is furnished arranged to be bolted to the face-

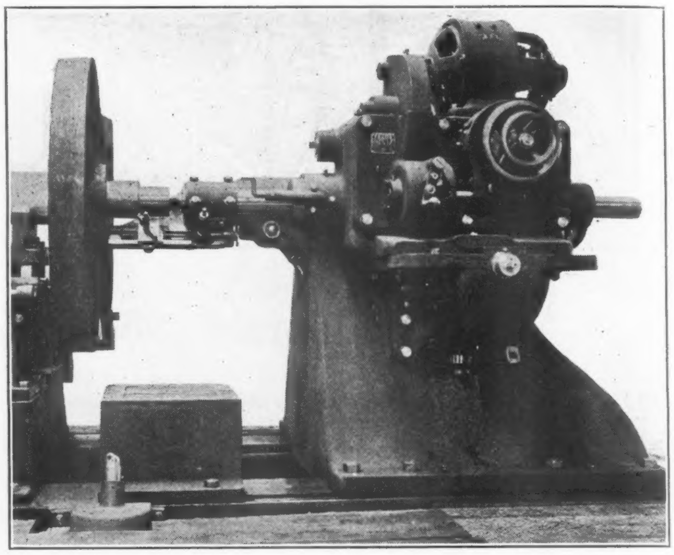


Turning a Pair of Inside Journals

plate and adjusted radially, and having an extended arm which projects out between the spokes of the driving wheels and clamps around the spokes. When the driver sets are in place in the machine the headstock is properly supported in a suitable bushing carried in the stationary spindle.

When trailer sets are to be turned, the left-hand journal is pocketed into the recess in the fixed spindle and the adjustable spindle drawn back into the stationary spindle, so as to properly support the axle. The other end of the axle is carried on the tailstock spindle. Trailer sets are chucked by the same means as the driver sets.

The face-plate is made so that, in itself, it is practically perfectly balanced, and therefore when handling trailer sets, the entire job will be in balance, insuring smooth journals



Crank-pin Turning or Boring Attachment

free from chatter marks. An adjustable counterweight is furnished for the face-plate so as to accurately balance up the entire job when turning journals of a pair of drivers. This adjustable counterweight may be set in one of two positions so as to properly balance up wheels with either a right or left-hand lead.

In order to facilitate the work of getting either drivers or trailers into the machine, both the headstock and the tailstock are made adjustable along the bed by means of 5-hp. motors through the medium of friction clutches, thereby allowing the carriage bases to remain in a fixed position. In addition to journal turning, the machine is also arranged so that quartering attachments can be bolted to both the headstock and tailstock, as well as a crank-pin turning attachment.

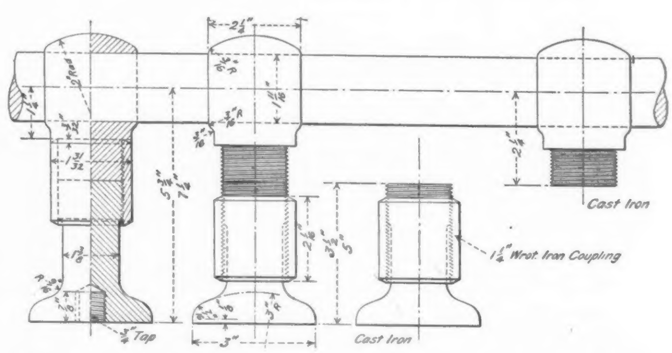
The maximum swing of the lathe is 90 in., the maximum distance between the face-plate and tailstock center being 10 ft. and the maximum distance between the centers 11 ft.

Easily Detachable Hand Rail Column

THE illustration shows a new hand rail column designed for strength and reliability and at the same time intended to be easily detachable. It has proved its value by extended tests on locomotives under actual service conditions.

As in the case of the ordinary type of one-piece hand rail column, a stud, screwed into the boiler shell, extends outward through the lagging and jacket and engages the base of the column. The column itself consists of three parts: first, a bottom section of cylindrical form with a base enlarged and provided with a threaded socket to receive the stud, the opposite end of the bottom section being threaded to engage the standard pipe coupling which joins the two sections of the column; second, the loop or eye portion of the column is threaded at its lower end to engage the pipe coupling previously mentioned; third, a 1½ in. pipe coupling joins together the top and bottom sections of the hand rail column. The relation of the respective parts to one another and the method of disconnecting the upper and lower sections are plainly shown in the illustration.

This hand rail column is neat in appearance and enables the workman to disconnect the top and bottom sections of the



Simplicity and Easy Removal Feature New Hand Rail Column

column, move the eye or loop portion of the column out of the way, unscrew the base section and detach the jacket, lag-

ging and so forth and perform necessary work on the shell of the boiler without disconnecting or removing the hand rail.

Many railroads utilize hand rails as conduits for head light wiring and the sectional hand rail column avoids the necessity of removing these wires preliminary to lagging removal. An additional advantage is due to the fact that the sectional hand rail column allows the hand rail itself to be made in one piece, if desired. This provides a safer rail than is sometimes the case where short sections are used. In the case of railing on the front end of the smoke box, the rail can be removed and repaired without opening up the front end.

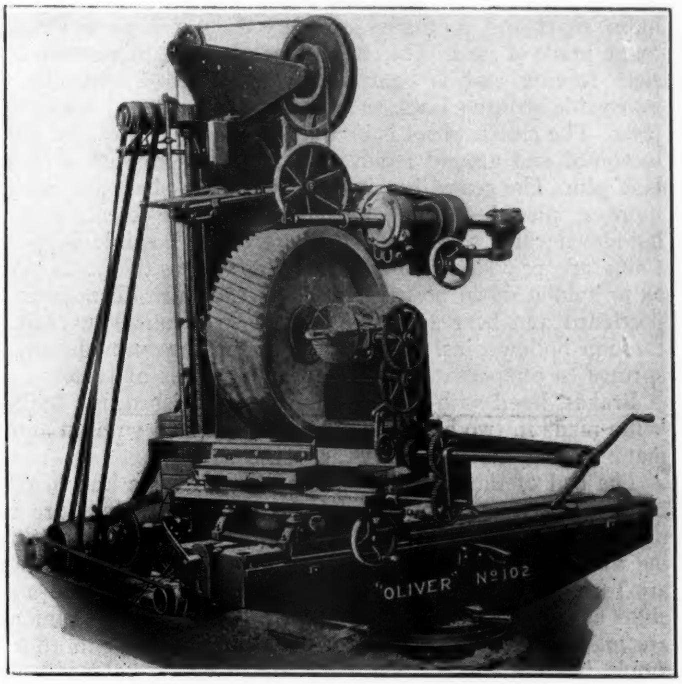
Practical experience with this type of sectional hand rail column has indicated that it is just as safe as the solid one piece type and that the labor saved on occasions where repairs are to be made which require the removal of the jacket will pay for the improved type of column within a short time. This device is covered by a patent, held by C. B. Baker, 3865a Flad avenue, St. Louis, Mo.

Device for Cutting Gear Pattern Teeth

THE Oliver Machinery Company, Grand Rapids, Mich., has recently developed a special attachment for its No. 102 pattern milling machine, to aid in cutting spiral, spur, bevel and worm gears. As shown in the illustration this attachment includes a 14-in. universal dividing head with tail stock, index plate, index chart, two face plates, a set of raising blocks, recessing change gears, quadrant and connecting mechanism between table and dividing head. The machine is so arranged that in cutting spirals the grea pattern rotates according to the spiral as the cutting progresses from the back to the front edge. This produces an accurate tooth form which would be extremely difficult to produce by hand.

The pattern shown in the illustration is for a spiral gear 33 in. in diameter and having a 10-in. face. By means of this gear cutting attachment all teeth are machined alike and uniformly spaced and the time required for the operation is obviously much less than would be needed to form the teeth by hand. In addition the accuracy obtained is greater.

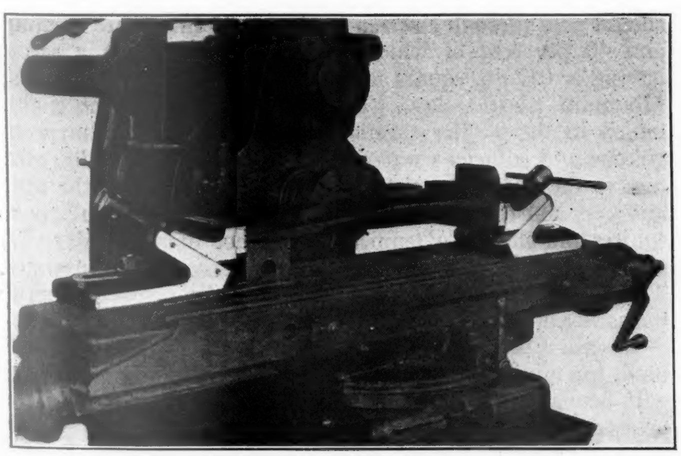
While railroad shops would seldom if ever be required to make patterns as large as the one illustrated the device can be used for smaller gear patterns of various kinds and is distinctly a time and labor saving device. Where conditions are such that any considerable number of gear patterns are to be cut the device is one which will save its cost many times over.



Oliver Gear Pattern Cutting Attachment

Divided Machine Vises Adjustable in Height

THE divided machine vises illustrated are adjustable in height and have an unlimited length of span. They have been developed recently for use on planing, milling, shaping, drilling, and other machine tables in place of the ordinary parallel vises, clamps and bolts. As shown they overcome the common deficiency of limited base plate lengths.



O. Z. Divided Machine Vises

The jaws can be placed parallel or crosswise or in any other position required by the shape of the work and are adapted to holding parallel, taper or irregular parts. The depth of the jaws from the top to the bottom is considerably greater than in ordinary vises and enables top-heavy work to be clamped with security.

The body and jaw of each vise is made of cast iron, the jaw being faced with hard steel, with a serrated surface to afford a good grip. The screw is made of steel with right and left-hand threads; the left-hand threads run in a solid nut on the moving jaw, and the right-hand in the nut secured to the body. Therefore for each revolution of the screw a movement of the jaws is obtained equal to twice the pitch of the screw, thus insuring rapid action. The jaw is held to the body by a sliding V, properly fitted and an adjustable steel gib and screws provide the necessary adjustments for wear.

In operation the combined parallel and downward movement of the two jaws forces the part held down to the table or parallels and saves the operator from using a hammer, an objectionable practice. The divided machine vises are made by O. Zernickow, New York, and can be furnished in three sizes with jaw widths of 2 3/16 in., 5 in. and 10 in., respectively. The heights of the vise jaws in the top position are 2½ in., 4½ in. and 7 in., the length of table occupied by

each jaw being 4½ in., 8½ in. and 13 in., respectively. The vises are supplied complete with operating levers and as the parts are interchangeable new parts can be ordered to replace damaged ones. The largest size of the machine vises is provided with two slots and four cross plates, so that it will suit tables with varying distances between slot centers.

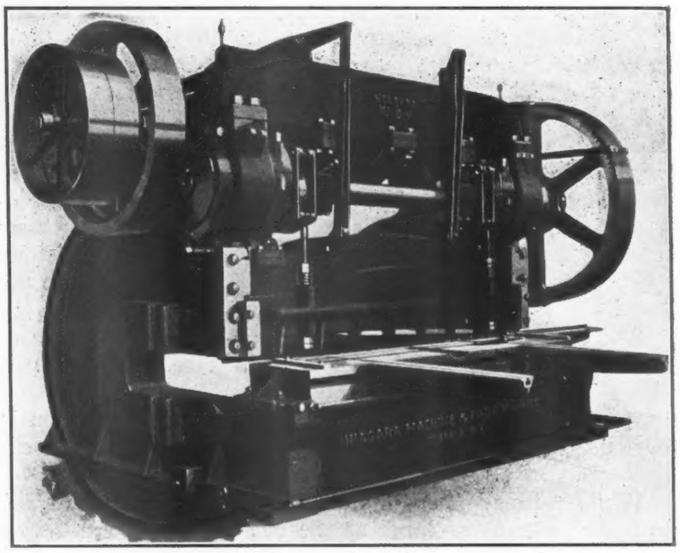
Power Sheet Metal Squaring Shear

The Niagara Machine & Tool Works, Buffalo, N. Y., has recently developed a power squaring shear designed to cut sheet metal up to ⅝ in. thick by 96 in. long. The crosshead of the machine is heavy and of the box section type. It is guided in broad, liberally proportioned ways, the proper arrangements being made for counter-balancing. The main shaft and eccentrics are forged in one piece from a tough grade of steel. The clutch block is made of a hammered steel forging and is equipped with hardened and ground removable striking jaws, as well as with hardened back-lash jaws. The clutch wheel is bronzed-bushed and provided with hardened and ground removable striking faces with a back-lash pin. The center bearings for the main shaft are two in number, placed as close as possible to the eccentrics and holddown cams so as to give the greatest possible support. Cams are provided to lift the holddown positively, as well as to hold it down positively. These cams are liberally proportioned and bear against hardened steel rollers lubricated through hollow pins. The holddown rods are provided with springs to compensate for various thicknesses of plates.

Brakes, lined with asbestos fibre are furnished, the brakes being made in two hinged halves and equipped with an automatic spring take-up for wear.

The bed of the machine is exceptionally wide and heavy, being screwed and doweled in place. The housings are of massive construction and do not require stay rods for cutting the maximum capacity rating. Stay rods and stay rod lugs are furnished on special order only. All gears for this machine are cut and provided with suitable guards. The pinions are made of hammered steel and are large enough to afford ample bearing surface and long life. Counter-balance rods are regularly placed so as to pass outside of the housings and not to interfere with the work. A complete set of front, side, bevel and slitting gages is provided; also a patented automatic screw adjusting back gage.

The driving mechanism for the machine is overhead, out of the way of the operator. Pressure of the cutter bar toward the back is taken up by solid metal and not by loose gibs. A 30-hp. motor is required to drive this power squaring shear in conjunction with a double gear giving a ratio of 15 to 1. The flywheel is 52 in. in diameter with a 9 in. face



Niagara Power Squaring Shear

and weighs 2,300 lb. The pulleys are 36 in. by 9 in. and run at a speed of 240 r.p.m. With a 24-in. gap this machine weighs 54,000 lb. and with a 36-in. gap 61,000 lb. The floor space required is 132 in. by 197 in., the overall height being 123 in.

Eliminating Blow Holes in Thermit Welds

A new grade of molding material has been developed recently by the Metal & Thermit Corporation, New York, and used to prevent blow holes and assure sound Thermit welds. It is designated as "Thermit Molding Material," being quite different from ordinary molding material, and is recommended for all Thermit welding work.

The design of the new molding material is based on the theory that good silica sand will stand the heat of the Thermit reaction and that the weakness in all molding material is the clay binder. There should be as little clay as possible in the mixture in order to make the mold more refractory and to increase its porosity and it is logical, therefore, to use plastic clay instead of a fire clay, as formerly. The sand and plastic clay are ground together in a foundry pan or Moller, with the intention of coating each grain of sand with a minimum thickness of clay. This has resulted in a good, clean molding material which should be rammed hard in the mold. It will stand up well under the preheating flame, and is extremely porous to the gases generated in the mold, resulting in a sound weld with a clean exterior. Although suitable molding material can be made by increasing the clay content slightly and mixing the clay and sand thoroughly by hand, it is not as good as that made with a smaller clay content in the foundry pan or Moller.

The mixture now being used is composed of the following: 3 parts of clean, sharp silica sand, (100 per cent of which should pass through a screen having a .03 in. square opening, and 40 per cent of which should be retained on a screen having a .012 in. square opening) mixed with 1 part Welsh Mountain plastic clay. These parts are first thoroughly mixed in the Moller together with 1/40th part glutrin by volume and sufficient water (1/12th part) to bring the mixture to the proper consistency. If mixed by hand, the sand and clay must be dried before mixing (being careful not to subject the clay to a temperature higher than 400 deg. F.) and thoroughly mixed before adding the glutrin and water. The glutrin should be mixed with the water before adding to the sand and clay.

In case a plastic clay, fatter than the Welsh Mountain, be used, the mixing will have to be more thorough and less clay will be used. Welsh Mountain clay is being used in the present mixture because in carefully run tests it has proved to be the most refractory. The use of the new molding material necessitates harder packing next to the weld; in fact,

the regular Thermit rammer may be supplemented by the use, for instance, of a tool having an end ⅜ in. by 1½ in., so that the operator may be able to peen the sand next to the wax collar and the various patterns.

It is absolutely essential, in the production of sound welds, to be sure that no loose sand exists in the mold when the Thermit steel is poured. This is why very hard ramming is advocated, also why it is most important to blow out all loose material from the interior of the mold by putting the preheating burner in the riser before the heating gate is plugged and being sure that no sand is detached by the operation of inserting this heating gate. The burner should be removed from the riser before plugging the heating gate, because otherwise it may detach some sand, which could not be blown out after the plug is in place. The heating gate plug should be thoroughly dry, and if it has been carried in stock for some time it should be warmed before using.

By perforating the sides and bottom of the mold box, the escape of the gases which pass through the molding material is greatly facilitated. Holes ⅜ in. in diameter, spaced 3 or 4 in. apart, are sufficient. To facilitate the escape of gas from the bottom of the mold box, the mold should rest on blocks, not directly upon the foundry floor. As unnecessary molding material simply increases the resistance to the passage of gas, the mold box should be made as small as possible commensurate with safety. For example, in welding a 4 in. by 4 in. section, only about 4 in. of sand is necessary at all points, except, perhaps, on the pouring gate side. It is most important to thoroughly vent the mold box by forcing a rod or wire down at a number of points to within about ½ in. of the collar. Precautions should be taken, however, that these do not touch the collar because such vent holes will fill with steel and will therefore prevent instead of facilitate the escape of gas.

Cold Junction Compensated Pyrometer

The feature of a special interest in a new thermo-electric pyrometer, placed on the market recently by the Brown Instrument Company, Philadelphia, Pa., is the method of automatically compensating for changes in cold junction temperature. This is an improvement on the method of cold junction compensation developed by Darling in England in 1909. Darling used what is called a Briguet spiral, or compound strip of two metals of different coefficients of expansion, but no means was afforded for setting the instrument to zero. The new patented Brown construction includes a method of setting the instrument to its proper zero, this being clearly shown in the illustration.

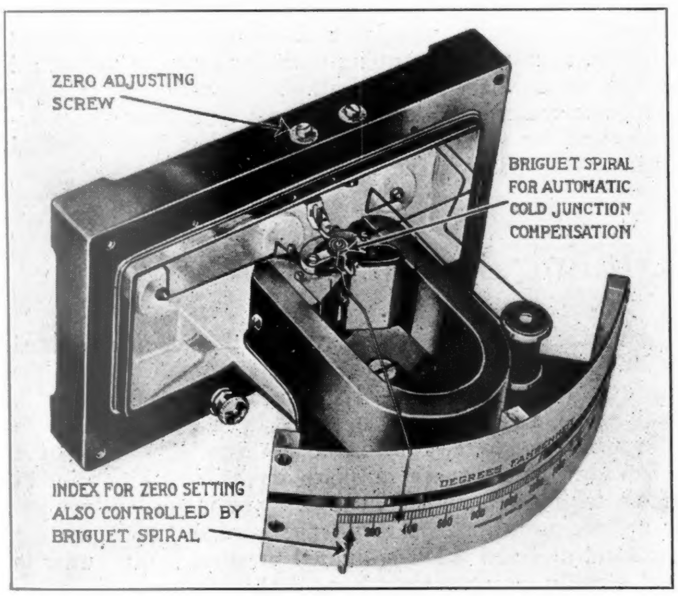


Fig. 1—Brown Compensated Pyrometer

The milli-voltage or e. m. f. developed by a thermo-couple is dependent on a difference in temperature between the hot and cold ends of the thermo-couple. To secure accurate measurements of temperature, it is therefore necessary that the cold end of the thermo-couple be maintained at a constant temperature or the instrument must be compensated for changes in temperature at the cold junction of the thermo-couple. It is common practice to use what are known as extension or compensating leads, as shown in Fig. 2, which will transfer the cold junction from the binding posts of the thermo-couple to a distant point. Heretofore, it has been necesary to locate the cold junction at the end of the extension of the compensating leads in a cold well in the ground or in a compensating box, where the temperature can be maintained constant. In the new Brown pyrometer the extension or compensating leads are brought to the meter. Changes in temperature at the end of the extension or compensating leads also take place in the meter itself, which is compensated for this change in temperature.

A Briguet spiral similar to that used by Darling is mounted in the instrument as shown and controls the springs and moving elements directly. A second index is provided which works with changes in temperature exactly in relation to the movement of the pointer controlled by the Briguet spiral attached to the moving element. After mounting the instrument the pointer is set by the zero adjusting screw to correspond with the index on the scale. If the values for a thermo-couple have been determined, based on a cold junction of 75 deg. F., the index will indicate 75 deg. F., provided the instrument is subject to this surrounding temperature. If the instrument pointer does not correspond with this index it is set accordingly. When the temperature surrounding the instrument and the cold junction of the end of the compensating leads at the instrument rises to 90 deg. F., the index automatically rises to 90 deg. F., and the Briguet spiral attachment to the instrument pointer causes it to move up to 90 deg. F., automatically adjusting for the temperature of the cold junction of the thermo-couple.

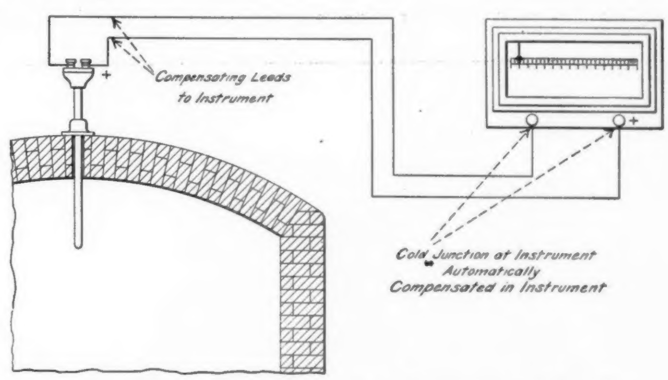


Fig. 2—Diagram Showing Use of Compensating Leads

Any number of thermo-couples with their extension or compensating leads can be brought to the one instrument having this automatic compensation. Likewise, recording instruments can be equipped with automatic compensation and means for offsetting the pointer to zero.

Gantry Drill for Tank Car Work

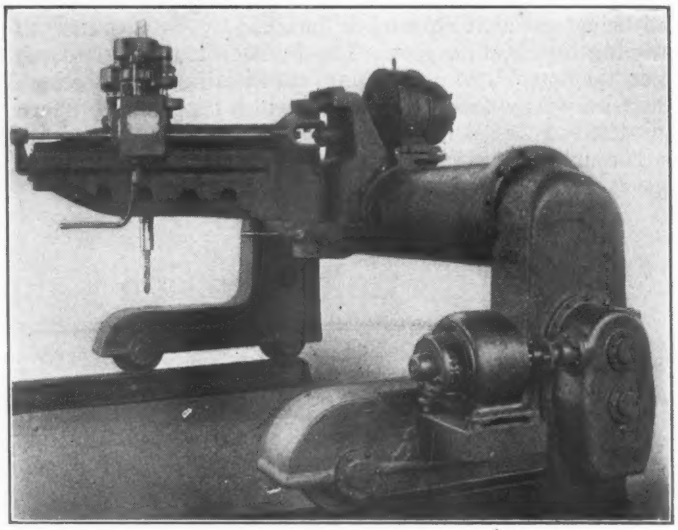
SOMETHING new in the line of drilling machines has been brought out recently by William K. Stamets, Pittsburgh, Pa., in the gantry drill illustrated. While this machine was designed and built for a tank car manufacturer it is obviously well suited for drilling holes in all kinds of steel plates and structural steel shapes and therefore adapted to use in boiler shops and steel fabricating plants. As shown in the illustration, the drill is mounted on a track the gage of which is wide enough to permit the drill to straddle any plates in which it is desired to drill holes. The span of the drill and the gage and length of track can be adapted to the requirements of the individual user.

The drill is a built-up structure mounted on four flanged wheels and arranged to be traversed back and forth on the track by means of a motor and adjustable controller shown at the right of the illustration. The motor is rigidly mounted on a bracket on the horizontal frame and connected through suitable reduction gears to one of the flanged wheels. As illustrated, these gears are amply guarded.

A drilling head is mounted on the radial arm, the latter being arranged to swing on its support on the cross-beam. The illustration shows only one radial arm and one drilling head but two, three or four arms and heads can be provided if desired. Two arms can readily be used on each side of the beams or if the span is increased, a larger number than four radial arms can be used. More than one drilling head can be mounted on each radial arm if so desired. In fact the entire arrangement is exceedingly flexible and can be adapted to meet the needs of any individual case.

Motive power to drive the drill is supplied by means of the motor mounted on the beam. With direct current this can be an adjustable speed motor but with alternating current a multi-speed motor is used, permitting a wide range of speeds through the combination of the electrically controlled changes with the mechanical changes of the drill head. Owing to the widely varying requirements of manufacturers who would use this type of machine, no standard machine has been made but each is designed and built on a special order.

This gantry drill is adapted to the requirements of manufacturers of tanks, gondolas or other types of steel cars or in fact any product involving drilling holes in the centers of



General View of New Gantry Drill

large plates, tanks, vessels or fabricated steel structures. Drilling, reaming and tapping operations can be performed as with the ordinary type of drill. The gantry drill is heavy enough to make clamping to the rails unnecessary and arrangement for clamping the radial arm has been provided by means of the lever indicated.

A Dynamometer for Milling Machines

WITH different combinations of feeds and speeds, the efficiency of the milling machine varies, and it is therefore important to have some means of determining the actual cutter pressures entirely independent of

Pollakoff Dynamometer Applied to Milling Machine

the efficiency of the machine or any part of its mechanism. For the accomplishment of this object, the Poliakoff dynamometer has been developed and placed on the market by the Cincinnati Milling Machine Company, Cincinnati, Ohio. The device provides means for reading the pressures exerted on any milling cutter while at work, in two directions, the readings being taken directly from the dials shown. A working table is provided, supported by a base plate which is in turn bolted to the table of the machine. The illustration shows the dynamometer in place on a No. 5 Cincinnati miller, taking a heavy cut in steel. The vertical downward or upward pressure of the cutter is read directly from the left hand dial and the longitudinal pressure of the cutter is read directly from the right hand dial. These are the pressures with which the designers and users of milling machines or milling cutters are most concerned. However, if it is also desired to obtain the crosswise pressure, i. e., the pressure in line with the milling machine arbor, the dynamometer can be mounted crosswise on the table.

In operation, a definite portion of the vertical load on the platen is carried to an hydraulic chamber placed centrally under the work table. This chamber is connected with the left hand gage which is graduated by trial in terms of the vertical load in pounds. The horizontal load is transmitted through bars, flexible vertically, to a crosshead which transmits the load to another hydraulic chamber placed between this crosshead and the end of the main frame of the dynamometer. This chamber is connected to the right hand gage by a pipe.

Heavy springs are used to put initial loads on each chamber so they will show loads in either direction. The fulcrums carrying the loads to the levers are so constructed as

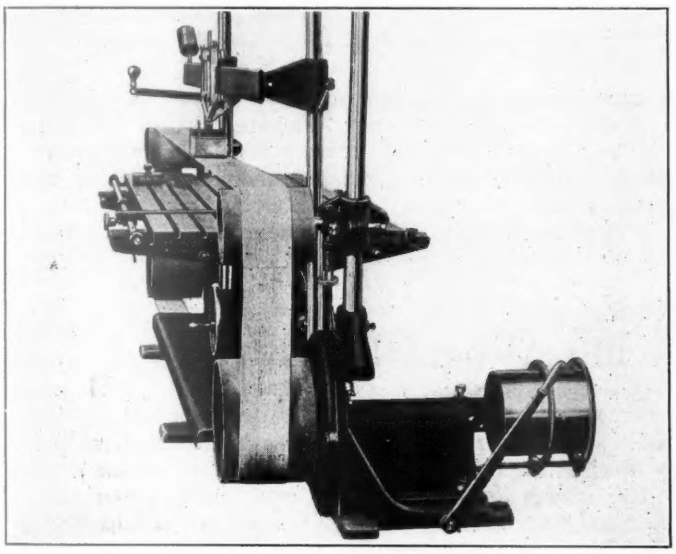
to be rigid against vertical and cross loads but flexible to longitudinal loads and the bars to the crossheads are flexible to vertical loads so neither system interferes with the action of the other. Guards are provided so that any desired lubrication or flooding of the cutter may be used.

The dynamometer has a capacity to withstand longitudinal loads of 25,000 lb. in one direction and 4,000 lb. in the opposite direction; vertical downward pressures of 10,000 lb. and upward pressures of 7,000 lb. The working surface of the working table is 16 in. long by 10 in. wide, and it is provided with three T-slots. The height of the working table above the bottom of the base is 8 in. The total size of the base of the dynamometer is 35 in. long by 14 in. wide.

The value of the dynamometer is evident for shops where milling operations are studied and given proper attention and the problems attending machines and cutter standardization can be more readily solved with its aid. Its use is not confined entirely to milling machines, but it is equally adaptable for making tests on planers, shapers, and with slight variations, drill presses.

Belt Sanding and Polishing Machine

RAILROAD car shop men will be interested in a new belt sanding and polishing machine recently put on the market by the Oliver Machinery Company, Grand Rapids, Mich. This machine, known as the Style 126 universal belt sander, has been designed for the rapid sanding and polishing of all kinds of line and edge moldings, flat and straight surfaces and for finishing built-up pieces. In railroad shops it should be adaptable to use in mill rooms and especially in pattern shops where it will save a large amount of hand finishing work.



Oliver No. 126 Universal Belt Sander

Speed of action, convenience of operation and safety are three important features claimed for this machine. It will be noted that the belt returns at the bottom under a suitable guard, thus eliminating the overhead belt and keeping all dust below the level of the operator's face. The belt runs down over the pulley, increasing the safety of the machine, preventing the breaking of sand from the belt and giving the belt a longer life. By means of a counter-shaft to take up the slack of the belt, a flexible tension to suit the work is maintained. The table rolls on ball bearings and runs easily so that a slight push will cause it to run the full travel of 36 in. The machine has a capacity to take work of any length and sand to the center of 72 in. It will take work on the table 54 in. high and over the floor 72 in. high. The table travels 36 in. with a vertical adjustment of 14 in. Sanding belts up to 10 in. wide may be used.

The table top is constructed of plain wood strips with 1-in. gaps between each strip. These gaps allow any dust that may accumulate to drop through, keeping the table top clean. The table is 32 in. wide by 96 in. long and is equipped with an adjustable bar to hold the work to be sanded. The idler is adjusted up or down to the height of the work and can also be adjusted in a tilting position to keep the sand belt from running to either side of the center. An edging attachment is made to apply to the power stand arm and is used for sanding edge work. It is composed of a belt plate adjustable table and can be raised or lowered at the will of the operator. It also has an attachment for sanding form edge moldings and irregular shapes.

The idler is adjustable up or down and is furnished with ball bearings. The machine is regularly equipped with a roller bearing countershaft for belt drive, or it may be arranged for motor drive if desired. The equipment consists of one sanding shoe, necessary wrenches and edging attachments. The machine is 80 in. high over all by 72 in. wide and weighs approximately 1,400 lb. It is arranged either with or without a sanding pad attachment according to the desires of the user.

Short-Turn Overhead Trolley System

ALTHOUGH the short-turn overhead trolley system, illustrated in Fig. 1, is comparatively a new departure, several successful installations have been made. The track consists of two parallel standard rolled channels, spaced 2⅛ in. between flanges and held in place by clamps. The track is designed to carry loads with no intermediate supports except at the splices, corners and switch points, and is fabricated to meet the requirements of each condition. One special feature of this system is that spanning a long gap, as from one building to another, can be done without intermediate supports by using a heavier section of channel.

The short-turn trolley system consists of the standard channels, 90-degree right switches, 90-degree left switches, 45-degree right switches, 45-degree left switches, and the universal switches. Each corner and switch connection is interchangeable so that at any time in the future a right corner can be removed and a double switch or universal switch bolted in the same place. The design and exceptional compactness of the short-turn universal switch gives much greater switching facilities and covers much greater space than any other switch.

All of the short-turn corners and switches have a track curvature of 18 in., practically turning the load at right angles. This is especially adaptable in foundries for serving a row of brass furnaces or machines close to the wall without losing valuable space by long sweeping curves. It is also a good feature in freight houses and terminals. This short-turn system can be extended out of the warehouse and along

the receiving platform so as to load goods into an open freight car or automobile truck. The system can also be readily wired should an electric hoist be desired in place of chain falls. The track is built and shipped and can be erected as single units, thus greatly reducing the cost of erection.

Special 2-wheel, 4-wheel, or 8-wheel trolleys are provided, the 4-wheel type being illustrated in Fig. 2. There are ball-bearing wheels *W* and guide rollers *R* which run between the toes of the channels, practically eliminating friction and making it difficult for the wheels to bind against the track

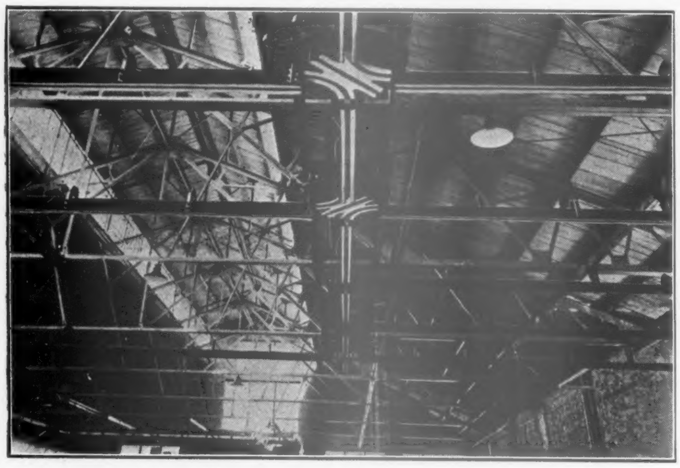


Fig. 1—View of Overhead Trolley System with Universal Switches

when rounding the curves. Carbonized steel ball bearings are shown at *B*, pivots at *P* and the hoist connection at *H*. The trolley runs on the level top of the channel tracks and is designed to swing in the same 18 in. radius curves. The fact that this track is built from standard rolled channels or can be built from I-beam sections where long spans and

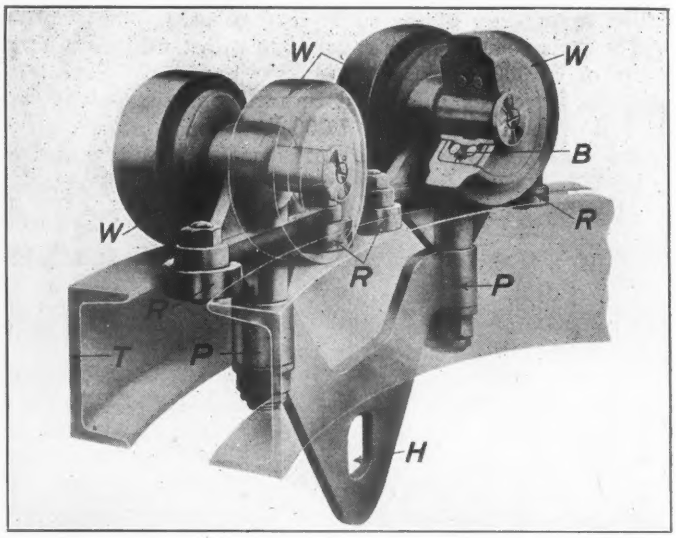


Fig. 2—Phantom View of Short Turn Trolley

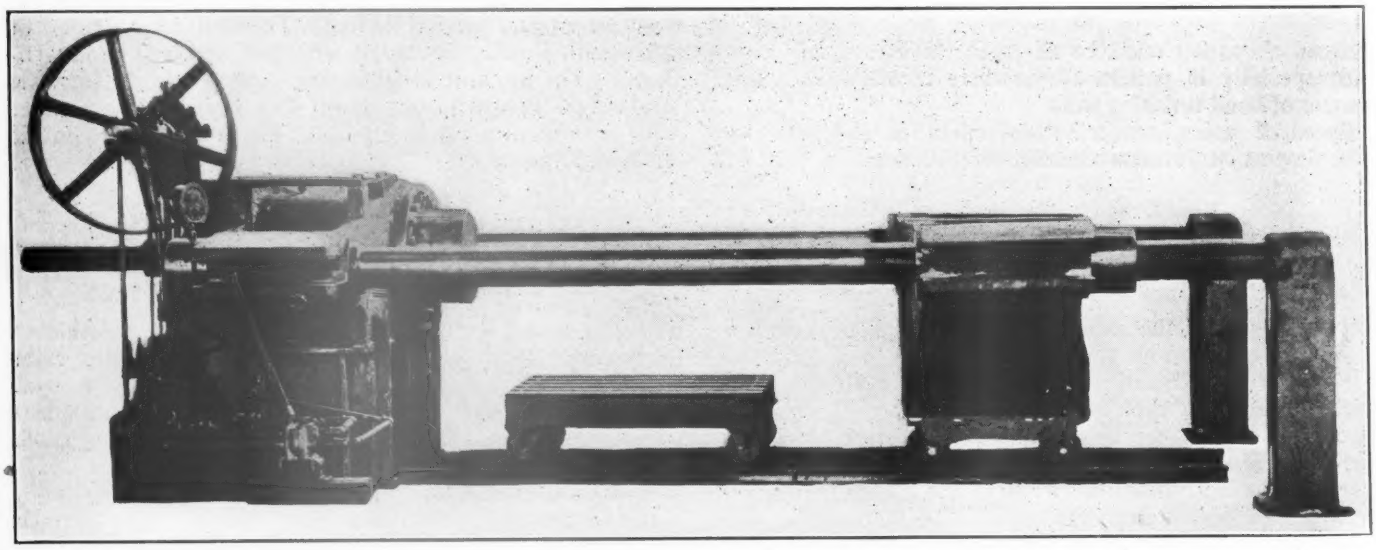
greater strength is required, makes it easy to obtain from local stocks and easier to erect. The operation of this system lightens the work and makes it much more easy and favorable for the workmen handling material, thereby decreasing labor turnover and increasing the efficiency of unskilled labor.

The system is being manufactured and sold by the Whiting Corporation, Harvey, Ill.

Special Hydraulic Driving Wheel Press

THE Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, designed and built the special hydraulic press, illustrated, which was recently sold by the Mc-Carter Cooper Company, New York, to the Compagnie General De Chemins De Fer & Tramways en Chine, Pekin, China. This press is used for forcing driving wheels on or off between strain bars is 84 in. and between ram and resistance head is 108 in. maximum. This may be decreased to 78 in. by moving the resistance head, which is mounted on wheels.

The press is also equipped with a belt-driven power attachment and three plunger pump with both low and high pressure plungers. The pump is equipped with hand and pres-



Hydraulic Press for Applying Driving Wheels to Crank Axles

the crank-axles of locomotives, a special design of press being necessary because of the crank throws.

The press will handle wheels 80 in. in diameter and less, being capable of exerting a force of 330 tons. The distance sure knock-outs whereby any one or all pump cylinders may be eliminated from service at will or automatically when the maximum pressure is reached. A small hydraulic cylinder and ram returns the main ram to its starting position.

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The railways of Great Britain were returned to their owners on August 14 after having been under government control since the beginning of hostilities in 1914.

Operation of the Missouri & North Arkansas has been discontinued, following a long series of difficulties which culminated recently in a strike of the employees.

The Union Pacific shops at North Platte, Neb., have been reopened after being closed 7 months. Approximately 45 per cent of the former employees have been rehired.

The net railway operating income of the railways in June was $51,778,000, which was $14,697,346 more than in May. The figures are those of 202 Class I railroads operating 235,548 miles of line.

The Cleveland, Cincinnati, Chicago & St. Louis re-employed men laid off since last February at its shops at Bellefontaine, Ohio, on July 25. The Bellefontaine shops are now running at normal capacity.

An average on-time record of 92 per cent was made by the fast freight service of the Chicago, Indianapolis & Louisville, between Indianapolis, Louisville and Chicago, during the months of May and June.

The operation of freight trains on Sunday in the State of Georgia, which has been allowed since 1917 by the Railroad Commission as a war measure, must now be stopped, except in the case of perishable and live freight, the commission having on August 10 revoked the permissive order.

The Railroad Division of the American Society of Mechanical Engineers has elected the following Nominating Committee to present nominations for next year: G. M. Basford, G. M. Basford Company, chairman; W. L. Bean, N. Y., N. H. & H., and Kenneth Rushton, Baldwin Locomotive Works.

The New York, New Haven & Hartford announces that the Railway Clerks' Union has agreed to modification of the wage schedule regarding the payment of overtime and other compensatory rates, the new schedule to remain in force pending the decision of the United States Railroad Labor Board.

Differences in the cost of labor do not include changes in the quality or effectiveness of labor but only changes in wages, the Interstate Commerce Commission held in a decision handed down on August 6, prescribing the principles to be followed in fixing the maximum amount to be included in the carriers' accounts for operating expenses for maintenance during the guaranty period of six months following the termination of federal control on February 28 last year.

A 20 per cent wage reduction applying to all employees of the National Railways of Mexico earning 100 pesos or more a month went into effect on August 1. Following the refusal of the railway directorate to rescind this order for a wage cut, the organized employees issued an ultimatum threatening a general strike if the former scale of compensation was not continued.

In awarding contracts for the repair of 32,000 freight cars, figures prepared by the Lehigh Valley reveal that these contracts have been let at a saving of over $308,000 to the company, as compared with the cost of making these repairs in its own shops. This saving is made even in the face of the recent reduction in wages and is due to the rules and working conditions affecting costs in the railroad shops with which the outside contractors do not have to contend.

The Long Island Railroad has received from the United States Railroad Labor Board a decision to the effect that it must negotiate concerning rules with System Federation No. 90, affiliated with the Railway Employees' Department of the American Federation of Labor. The officers of the System Federation are all employees of the Pennsylvania Railroad. The officers of the Long Island declared they would deal only with their own employees, and the union took the case to the Labor Board.

The strike of the 302 members of the federated shop crafts on the Cincinnati, Indianapolis & Western, which started on July 22, because the railroad would not pay the men time and one-half for overtime, has been called off, and about half of the men have returned to work. They will be received by the company, however, as new men, having lost their seniority rights by their walk-out. B. A. Worthington, president of the road, states that the new men who were taken on to fill the positions of the strikers will not be discharged to give room for the returning men.

As a result of the new system for the classification of cars for the expedition of trains through yards, the Baltimore & Ohio accomplished a saving of 61,167 engine hours during the month of June, 1921, as compared with June, 1920. Statistics on the relative number of cars handled during the month of June for the two years is not available for the entire system, but on the Eastern lines the number handled in June, 1920, was 522,113, as compared with 553,991 in June, 1921. The cars handled per engine hour were increased from 6.7 cars in June, 1920, to 8.5 cars in June, 1921, an increase of 27 per cent.

Frederick I. Cox, of New Jersey, was on July 22 nominated by the President as a member of the Interstate Commerce Com-

mission in place of Edgar E. Clark, whose resignation took effect on August 31. The nomination was confirmed by the Senate on August 23. Mr. Cox was a silk salesman, for many years connected with Belding Brothers and Company, manufacturers, of New York City, and his appointment was made on the recommendation of the National Council of Traveling Men's Association, endorsed by Senator Frelinghuysen, of New Jersey. This association conducted a campaign in behalf of Mr. Cox last April, when the President made the appointments called for under the law enlarging the Commission. Mr. Cox was born on May 25, 1870, at Rockaway, N. J., and now resides at East Orange, N. J. He has been in mercantile pursuits throughout his business life. His appointment is for a term expiring on December 31, 1926.

Erie's Leases Marion Shops and Roundhouse

The Erie on August 15 announced that its local shops and roundhouse at Marion, Ohio, had been leased to the Railway Service Company of Marion, an organization of local manufacturers and capitalists, and that their operation by the new company would begin immediately. The announcement of the new plan was made by W. A. Baldwin, manager of the Ohio region of the Erie.

Mexican Locomotive Situation Improves

According to Assistant Trade Commissioner Cornell, 130 locomotives have been purchased in this country by the Mexican government. Of these, 85 were obtained on a rental basis with the view of ultimate purchase and 45 by outright purchase. On these cash payments of from 15 to 20 per cent have already been made. These purchases presumably do not include the recent purchase of 65 locomotives from the Baldwin Locomotive Works.

Anthracite Shipments in July

Shipments of anthracite in July are reported at 5,462,760 gross tons as compared with 6,031,937 tons in the preceding month, and 6,389,100 tons in July, 1920. There is a continued slack demand for pea and steam sizes, which has caused the closing down of a number of individual operations; and there has been considerable idleness from petty strikes in the Lehigh and Wyoming regions.

High Average of On Time Trains on the Pennsylvania

The Pennsylvania Railroad reports that in the Central Region on Tuesday, the 16th of August, 971 or 98.8 per cent of the 983 passenger trains operated in that territory arrived at their destinations on time and 982 trains or 99.9 per cent maintained schedule or better. The best previous daily record was made on July 25, when 99.7 per cent of the trains maintained schedule. In the month of July 98.9 per cent of the trains made schedule, an improvement of 3 per cent over July, 1920.

Electrification of the Victorian Railways

It is reported in the *Times* (London) Trade Supplement that the Victorian Railways Commissioners (Australia) are about to convert a further 100½ miles of their lines from steam to electric traction and that the work is to be completed by the end of February, 1923. In addition to this electrification, which covers the passenger carrying routes, a number of lines exclusively used for freight traffic are to be converted and the electric system extended over several of the busier sections of the country lines.

150 Cars, Eleven Miles an Hour

On August 7, the Ann Arbor Railroad ran what is said to be the longest freight train ever operated in the State of Michigan. It was from Owosso, Mich., southward to Toledo, Ohio, 104 miles. The train left Owosso at 6:15 a. m., with 53 loads and 97 empties, weighing 3,932 tons, and arrived at Toledo at 4:00 p. m., with 53 loads and 98 empties, weighing 3,951 tons. It was hauled by one locomotive of the Santa Fe type with 70,000-lb. tractive effort, equipped with duplex stokers, except that a pusher was used for four miles out of Owosso.

"Fuel Economy Month"

September has been designated as Fuel Economy Month by the Illinois Central and the campaign will apply to all departments using coal. The goal for the month has been set at 20 per cent less than the September record in former years. The best previous month's record in freight service was 133 lb. per 1,000 gross ton miles in June, 1918; in passenger service the best month's record was 1,637 lb. per 100 passenger car miles for August, 1916; while in switching service the best record was 117 lb. per switch engine mile in September, 1918. Weekly progress reports will be made by the divisional fuel committees.

D., L. & W. Electrification Bids Rejected

All bids for supplying electrical equipment for the Delaware, Lackawanna & Western's proposed electrification of some of its mileage in the Scranton, Pa., district have been rejected. July 29 was the last day upon which bids could be submitted. They were opened immediately and it was found that all were unsatisfactory. Gibbs & Hill, consulting engineers for the Lackawanna, who received the bids, may advertise for new offers soon. The General Electric Company and Westinghouse Electric & Manufacturing Company were the only two companies that submitted bids for furnishing the heavier equipment.

French Railway Places Order with Westinghouse

An order for electrical equipment amounting to $1,200,000 has been received by the Westinghouse Electric International Company from the Midi Railway of France. The order includes transformers, synchronous condensers, lightning arresters and other substation equipment. The Midi Railway operates an extensive system, starting from Bordeaux, running through Toulouse to Cette, with many branches. The section on which the Westinghouse equipment will be used extends from Pau to Toulouse in the Pyrenees mountains, near the Spanish border. The line passes through Tarbes and St. Gaudens, and has a total length of over 100 miles.

French Electrification Program

The huge electrification program, the execution of which is being seriously undertaken by the French steam railway lines, involves electrification within the next 15 years of approximately 6,000 miles of main lines mostly already double track and the building of hydro-electric plants and high tension transmission lines of the first magnitude. French engineers have gone so far as to promulgate a tentative program involving electrification of over 1,200 miles of main line per year and putting into service of not less than 400 new electric locomotives every year. Financial considerations will probably greatly curtail such a program, but the more conservative one of the electrification of 6,000 miles within fifteen years will involve buying between 200 and 300 new electric locomotives per year, which is a bigger project than has yet been undertaken in any other country.

Wood Preservers' Association Has Established Service Bureau

The American Wood Preservers' Association has established a service bureau to promote the use of treated timber and thereby conserve the forest resources of the country. This bureau is prepared to furnish information concerning the uses to which treated timber may be applied economically, to answer inquiries regarding the relative durability of treated and untreated woods, and to supply other data concerning the use of timber treated with the standard preservatives, such as zinc chloride and creosote. Headquarters have been established at 10 S. La Salle street, Chicago, and P. R. Hicks, engineer in forest products of the United States Forest Products Laboratory at Madison, Wis., has been appointed secretary-manager.

M. K. & T. Locomotive Makes Record Run

Missouri, Kansas & Texas locomotive No. 392, a coal burning Pacific type of 41,000 lb. tractive effort, recently made a continuous run of 1,024 miles, so far as is known the longest on record. The occasion was the movement of a special train of Shriners from Waco, Tex., to Kansas City, on the way to the Shriners' convention at Des Moines. The locomotive was suitably decorated at Denison, Tex., and ran light to Waco, where it was immediately turned and started on its trip on the Shriners' special. The average speed on the trip was 40 miles an hour. The engine was in perfect condition upon arrival at Kansas City, and because of its elaborate decorations it was desired to run it to Des Moines, but it was too heavy for the connecting line to handle.

Bad Order Cars

According to reports compiled by the Car Service Division of the American Railway Association, the number of bad order freight cars on July 1 totaled 354,661, or 15.4 per cent, as compared with 15.1 per cent on June 15. On July 15, cars in need of repair totaled 365,092, or 15.9 per cent of the cars on line, and on August 1 the bad order cars totaled 376,417, or 16.3 per cent.

Surplus Serviceable Cars

The average number of serviceable surplus freight cars for the first eight days of July, according to the reports compiled by the Car Service Division of the American Railway Association, was 369,525, a decrease of 4,266 cars as compared with the previous week.

An increase of 2,525 cars was shown for the week ended July 15, or a total of 372,050.

On July 23, the surplus cars numbered 350,772, a reduction of 21,278 cars when compared with the total on July 15.

On July 31, the cars totaled 321,781, a decrease of 28,991 cars when compared with the preceding week.

The total on August 8 was 297,784 serviceable cars, a decrease of 23,997 cars, as shown for the week ended July 31.

Wage Reductions in Canada

By a tentative agreement between the Railway Association of Canada and Division 4, Railway Employees' Department, American Federation of Labor, the railway employees in the locomotive and car departments, as specified in wage agreement No. 4, are now receiving a decrease of 8 cents per hour.

A similar agreement with United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers has resulted in tentative reductions, as follows: All maintenance of way foremen and signal construction foremen, 80 cents per day; carpenters and other skilled workmen, 10 cents per hour; track laborers, crossing watchmen, bridge tenders and other laborers, 8½ cents; signal maintainers, 8 cents; signal helpers and helpers of maintenance mechanics, 7 cents; roundhouse laborers and ash pit men, 10 cents; pumpmen, $17.34 per month; signal men at interlocked crossings, $12.24.

Executives Decline to Comply With Brotherhoods' Requests

The Eastern Presidents' Conference at a meeting in New York on August 11 adopted the recommendation of its sub-committee that the executives reject the demands of the brotherhoods that the carriers restore wages to the level in effect on June 30 and pledge themselves against application for further reductions and against the elimination of time and a half pay for overtime. This was telegraphed to the leaders of the brotherhoods at Chicago. Executives in the Western, Southeastern and Southwestern regions rejected similar requests by the unions. It is understood that the New York decision was based upon the requirement of the transportation act that the railroads be managed in an economical and efficient manner; also to the fact that the 12 per cent wage reduction was effected on July 1 by the authorization of the United States Railroad Labor Board in decision No. 147, and that decision No. 119 of the board gave the carriers full authority to negotiate new working rules with their employees.

Freight Car Loading

The total number of revenue freight cars loaded for the week ended July 9, according to records compiled by the Car Service Division of the American Railway Association, was 639,698, a decrease of 156,493 cars as compared with the corresponding week last year, and of 170,147 cars as compared with the corresponding week in 1919.

The total for the week ended July 16 was 776,252 cars, an increase of 136,554 cars over the preceding week when, however, the observance of Fourth of July resulted in a drop in the total. 166,599 cars more were loaded during the corresponding week in 1920, which was 126,044 cars less than were loaded during the corresponding week in 1919.

During the week ended July 23, 790,348 freight cars were loaded. This was an increase of 14,096 cars over the preceding week, but was, however, a decrease of 138,070 cars when compared with the corresponding week of 1920, and a decrease of 119,334 when compared with the corresponding week of 1919.

796,570 cars was the total loaded for the week ended July 30, an increase of 6,222 cars over the week ended July 23. During the corresponding weeks of 1919 and 1920, 925,195 and 936,366 cars, respectively, were loaded.

A total of 784,781 cars loaded with revenue freight was shown in the association's report for August 6. This was a decrease of 11,789 when compared with the preceding week; a decrease of 87,292 and 150,947 when compared with the corresponding weeks of 1919 and 1920.

Locomotives

The Imperial Government of Japan has ordered, through Takata & Company, New York, 2 electric freight locomotives from the Westinghouse Electric International Company. The locomotives will weigh 62 tons and will have 1,000 h.p. capacity.

The National Railways of Mexico have ordered from the Baldwin Locomotive Works, 10 Pacific type locomotives, 15 Mikado, 20 Consolidated and 20 narrow-gage.

Freight Cars

The Katanga Railway (Africa) has placed orders with Belgian car builders for 60 gondola cars.

The Russian Soviet Government, according to a dispatch from Montreal, Que., has given the Canadian Car & Foundry Company, Ltd., a $2,000,000 order for 500 50-ton tank cars.

The Atlantic Fruit Company, New York, has ordered 100 cane cars of 20-ton capacity from the Magor Car Company.

Shop Construction

Atchison, Topeka & Santa Fe.—This company has awarded a contract to E. F. Ware, El Paso, Tex., for additions to its power house at Albuquerque, N. M., to cost approximately $150,000.

Chicago, Rock Island & Pacific.—This company will construct a new car repair shop at Trenton, Mo., with company forces.

Chicago, Rock Island & Pacific.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of an 8-stall roundhouse at Amarillo, Tex. The building will have brick walls and a timber frame and roof, and is estimated to cost about $35,000.

Illinois Central.—This company has awarded a contract to G. A. Johnson & Son, Chicago, for the construction of a frame enginehouse, with dimensions of 60 ft. by 200 ft., at Herrin, Ill.

Missouri Pacific.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of 5 car-repair sheds. These sheds will be of frame construction, 40 ft. wide by 240 ft. long, and will be built at Crane, Mo., Council Bluff, Sedalia, Jefferson City and Nevada. The total cost of this work is estimated at about $55,000.

Contracts for Car Repairs

The Georgia Railway is making repairs to 125 box cars, in its shops at Augusta.

The Lehigh & New England is having repairs made to 300 box cars at the shops of the Middletown Car Company, Middletown, Pa.

The Erie has given a contract to the Illinois Car Company, Urbana, Ohio, for the repair of 400 40-ton box cars.

The Virginian Railway is having repairs made to 150 hopper cars, of 50-ton capacity, at the shops of the Virginia Bridge & Iron Company.

The Central of Georgia is having repairs made to 200 box cars, in its own shops.

The Atlantic Coast Line is having repairs made to 350 box cars, in its own shops.

The Pittsburgh & West Virginia is having repairs made to 300 hopper cars at the shops of the Koppel Car Repair Company, Koppel, Pa.

The Erie has entered into a contract with the Greenville Steel Car Company, Greenville, Pa., for the repair of 500 coal cars, of 50 tons capacity.

The Delaware, Lackawanna & Western has given contracts for the repair of box cars to the Magor Car Company for 500, to the Buffalo Steel Car Company 500, and the American Car & Foundry Company 500.

Buffalo, Rochester & Pittsburgh will make repairs to a

total of 2,000 30-ton wooden box cars. The company has given a contract to the Buffalo Steel Car Company for repairs to 500, 50-ton hopper cars and is having repairs made to 500 box cars in its own shops at Du Bois, Pa.

THE NEW YORK CENTRAL has given contracts for the repair of freight cars as follows: For the New York Central, 500 box cars to the Ryan Car Company; 500 box cars to Streator Car Company; 500 box cars to Standard Steel Car Company; 500 hopper cars to American Car & Foundry Company, and 500 hopper cars to Buffalo Steel Car Company. For the Pittsburgh & Lake Erie, 500 box cars to Pressed Steel Car Company, 1,000 hopper cars to Standard Steel Car Company, and 500 gondola cars to the Youngstown Steel Car Company. For the Cleveland, Cincinnati, Chicago & St. Louis, 500 general service cars and 500 hopper cars to American Car & Foundry Company. For the Michigan Central, 500 box cars to the Illinois Car & Manufacturing Company, and for the Lake Erie & Western, 500 box cars to Haskell & Barker Car Company.

THE LEHIGH VALLEY has awarded contracts for the repair of equipment, as follows: American Car & Foundry Company, 1,000 box cars; Magor Car Corporation, 1,000 box cars; Buffalo Steel Car Company, 500 steel coal cars; American Car & Foundry Company, 500 steel coal cars; Lehigh Structural Steel Company, 200 steel coal cars.

THE CHICAGO GREAT WESTERN is having repairs made to 198 box cars, at the shops of the Ryan Car Company, Chicago.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago. Convention September 12-14, Hotel Sherman, Chicago, Ill.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention September 19-24, Indianapolis, Ind.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Next meeting September 13, Windsor Hotel, Montreal. Paper on "Train Operation by Telegraph vs. Telephone," by W. J. Camp, asst. mgr. C. P. R. Telegraphs.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago. Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meeting second Tuesday of February, May, September and November, at Hotel Sinton, Cincinnati.

DIXIE AIR BRAKE CLUB—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 715 Clarke Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meeting second Tuesday of each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meeting second Friday of each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Next meeting September 19. Paper on "A Shipper's View of the Evolution of Transportation and Its Effect on Steam Railways," by George C. Conn, director of traffic of the Buick Motor Co. Buffet luncheon following.

PERSONAL MENTION

GENERAL

M. MCKERNAN has been appointed superintendent of safety of the Missiouri Pacific, with headquarters at St. Louis, Mo., succeeding R. H. Dwyer, who has been assigned to other duties.

E. J. BRENNAN has been appointed superintendent of motive power of the Chicago Great Western, with headquarters at Oelwein, Iowa, effective August 15, succeeding H. C. Eich, resigned.

G. C. SEIDEL, master mechanic of the Minneapolis & St. Louis, with headquarters at Marshalltown, Iowa, has been appointed mechanical engineer of the Chicago & Alton, with headquarters at Bloomington, Ill., effective August 13, succeeding J. H. Leyonmarck, deceased.

JAMES I. MAILER, whose promotion to superintendent of motive power of the Fort Smith & Western, with headquarters at Fort Smith, Ark., was announced in the August issue of the *Railway Mechanical Engineer,* was born at Alma, Wis., on April 24, 1877, and entered railroad service in December, 1893, on the Winona & Western. In 1897, he was employed by the Chicago Great Western as a machinist where he served until 1899, when he went with the Great Northern as a fireman. In 1900, after firing on the Northern Pacific and Southern Pacific he returned to the Chicago Great Western as shop foreman. A year later he was appointed general foreman of the Minnesota North Wisconsin where he served until 1904. Mr. Mailer has been in the service of the Fort Smith & Western continuously since 1904. From 1904 to 1906 he served as general foreman at Fort Smith, and from 1906 until January 1, 1921, he was employed as an engineman. On the latter date he was promoted to master mechanic and was serving in this position at the time of his recent promotion.

James I. Mailer

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

G. L. ERNSTROM has been appointed road foreman of engines of the Yellowstone division of the Northern Pacific.

T. ALLISON has been appointed road foreman of engines of the Pasco division of the Northern Pacific, with headquarters at Pasco, Wash., effective August 17, succeeding R. E. Wilkinson, who has been granted an extended leave of absence.

SHOP AND ENGINEHOUSE

M. J. MANION has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific at Pratt, Kans.

R. E. DETRICK has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific at El Reno, Okla.

H. SCHMIDT has been appointed roundhouse foreman of the Erie Railroad, at Cleveland, Ohio, succeeding E. Vlk.

CAR DEPARTMENT

J. R. SANDERSTROM has been appointed assistant car foreman of the Chicago, Rock Island & Pacific at Herington, Kans.

PURCHASING AND STORES

C. C. KYLE has been appointed acting general storekeeper of the Northern Pacific, with headquarters at St. Paul, Minn., effective August 17, succeeding O. C. Wakefield.

R. H. JOHNSON, general manager and purchasing agent of the Peoria & Pekin Union, with headquarters at Peoria, Ill., has resigned and the purchasing department has been placed under the jurisdiction of the president's office.

H. S. BURR, general superintendent of stores of the Erie with headquarters at New York, has been appointed assistant to the manager of stores with the same headquarters. C. K. Reasor has been appointed to a similar position with the same headquarters. The positions of general superintendent of stores and assistant general superintendent of stores have been abolished.

GORDON THOMAS has been appointed division storekeeper of the Wyoming division of the Lehigh Valley at Coxton, Pa., succeeding P. H. Shay, resigned. C. J. Roesch has been appointed division storekeeper of the M. & H. division at Stockton, Pa., succeeding Mr. Thomas. W. J. McKaig has been appointed division storekeeper of the New York division, with headquarters at Jersey City, N. J., succeeding Mr. Roesch.

OBITUARY

M. FLANAGAN, general master mechanic on the eastern district of the Great Northern died at St. Paul, Minn., on August 2.

J. H. LEYONMARCK, mechanical engineer of the Chicago & Alton with headquarters at Bloomington, Ill., died at his home in that city on August 1.

F. F. GAINES, formerly superintendent of motive power of the Central of Georgia, died at Washington, D. C., on August 26. Mr. Gaines was born on March 28, 1871, at Hawley, Pa. He entered railway service in 1888 as a freight and ticket clerk for the Erie. Two years later he resigned to enter Cornell University, at which institution he studied for the following four years. Upon leaving the university he served in the shops of the Erie for a time and in August, 1895, became a draughtsman for the Lehigh Valley and the following year was appointed engineer of tests. In April, 1897, he was promoted to mechanical engineer and in November, 1902, was appointed master mechanic. Two years later Mr. Gaines became mechanical engineer of the Philadelphia & Reading and in 1906 he went to the Central of Georgia as superintendent of motive power. In 1917 Mr. Gaines resigned as superintendent of motive power on account of ill-health but continued in the service of the company. In July, 1918, he was appointed a member of the committee of standards of the Railroad Administration and the following year was elected chairman of the Board of Wages and Working Conditions. He subsequently served as a member of Railway Board of Adjustment No. 3. Mr. Gaines was well known for his work in improving combustion and was the inventor of the Gaines locomotive furnace. He served as president of the Master Mechanics' Association for the year 1914-1915.

F. F. Gaines

THE CHICAGO, ROCK ISLAND & PACIFIC has created a new department of personnel and public relations under the supervision of H. S. Ray, assistant to the president. Mr. Ray will be especially concerned with the maintenance of cordial relations between the management and the employees.

SUPPLY TRADE NOTES

The Barrett Company on August 1 removed its offices from 17 Battery Place to 40 Rector street, New York City.

The Tuco Products Corporation, New York, has opened an agency at Spokane, Wash., in charge of L. J. McNally.

The O. M. Edwards Company, Inc., Syracuse, N. Y., has moved its Chicago, Ill., office to 532 First National Bank building.

F. C. Severin, New York manager, with office at 50 Church street, of the Betts Machine Company, Rochester, N. Y., has resigned to go into other business.

The T. H. Symington Company, New York, has created a new Northwestern district for the selling of its products. J. F. Schurch, vice-president of this company, and also president of the Railway Supply Manufacturers' Association, who has been in charge of the Symington office at Chicago for several years, is in charge of this district with headquarters in St. Paul, Minn. The Chicago office is in charge of Le Roy Kramer who has been elected vice-president and director of the company. He assumed his new duties on August 1. Mr. Kramer spent many years in the operating departments of the St. Louis-San Francisco and the Rock Island railroads and for six years was vice-president in charge of manufacturing for the Pullman Company. During the war he acted as federal manager of the St. Louis-San Francisco and the Missouri, Kansas & Texas railroads at St. Louis under the United States Railroad Administration. He left there in the Spring of 1919 to become vice-president in charge of production for the Willys-Overland plant at Toledo, and was also for a time vice-president of the Pierce-Arrow Company at Buffalo.

LeRoy Kramer

A. Clarke Morre has resigned as assistant to president of the Globe Seamless Tube Company, with which he has been connected since November, 1919.

John Duncan, vice-president of the Wheeling Steel Products Company, Wheeling, W. Va., has resigned to engage in the operation of coal, coke, iron ore and railroad properties in Illinois.

The Glidden Company, Cleveland, O., and its affiliated companies have been given the manufacturing and distributing rights, in North America, for the Holland enamel paint known as Ripolin.

Stewart C. Wilson has been appointed Pittsburgh district sales manager of the Whiting Corporation, Chicago, succeeding Robert S. Hammond, who has been transferred to the Chicago office.

E. A. Woodworth, formerly with the Imperial Belting Company, Chicago, as railroad representative, has left the service of that company to take charge of the southwestern territory for the United States Metallic Packing Company, Philadelphia, Pa., with headquarters in Chicago.

L. M. Waite, formerly sales manager of the National Acme Company, Cleveland, Ohio, and later sales manager of the Springfield Automatic Screw Machine Company, Fitchburg, Mass., has been appointed sales manager of the Garvin Machine Company, New York, succeeding Frank A. Power, resigned.

TRADE PUBLICATIONS

Thread Micrometer.—The Bath internal thread micrometer and master ring are illustrated and described in Bulletin No. 20, a 4-page leaflet issued by John Bath & Co., Inc., Worcester, Mass.

Thread Cutting Tools and Machines.—The Geometric Tool Company, New Haven, Conn., has issued a booklet of 20 pages illustrating its line of screw thread cutting tools and machines.

Cranes.—Typical illustrations of a line of Northern bucket cranes in actual operation are shown in Bulletin No. 520-B, recently issued by the Northern Engineering Works, Detroit, Mich.

Sharon Standards.—An illustrated catalogue of 8 pages intended to give some idea of its resources and facilities for handling pressed steel requirements, has recently been issued by the Sharon Pressed Steel Company, Sharon, Pa.

Valves.—An unusual set of 12 circulars, in each of which a particular line of valves suitable for various steam pressures is briefly outlined and illustrated, has recently been issued by the Walworth Manufacturing Company, Boston, Mass.

Powdered Coal.—Two booklets on the Use of Pulverized Coal Under Central Station Boilers, by John Anderson, and Powdered Coal Application to Four 2,640 H.P. Boilers, by H. D. Savage, are being distributed by the Combustion Engineering Corporation, New York.

Signaling Systems.—Some of the products manufactured by the Holtzer-Cabot Electric Company, Boston, Mass., including fire-alarm systems, calling systems, watchmen's clock systems, etc., are briefly described in a 14-page, illustrated booklet which the company has recently issued.

Valves.—The ease with which worn parts may be removed and replaced in "Flatplug" valves, which have been designed to meet the need for tight valves in varied uses and for working pressures up to 175 lb., is explained and pictured in an interesting folder recently issued by the Everlasting Valve Company, Jersey City, N. J.

Truck Bearings.—The advantages and methods of installation of Hyatt bearings for trucks of all kinds are outlined in the first few pages of a 16-page report recently issued by the Hyatt Roller Bearing Company, New York. The remaining pages contain a number of clear-cut illustrations of Hyatt equipped trucks made by leading manufacturers.

Chucks.—Prices and code words for the different styles of chucks manufactured by the Cushman Chuck Company, Hartford, Conn., are listed in a 16-page illustrated booklet which the company has recently issued. The booklet is neatly arranged and has an outside cover of transparent celluloid to which a small blotter is attached.

Steam Jet Ash Conveyors.—The Conveyors Corporation of America, Chicago, has recently issued a booklet entitled "The Proof of the Pudding," which contains reproductions of 70 letters regarding the service obtained with American steam ash conveyors. The list of users who commend this device includes several prominent railroads.

Welding and Cutting Apparatus.—Condensed statements of range and adaptation of Rego cutting and welding apparatus are given in Catalogue No. 23 recently issued by the Bastian-Blessing Company, Chicago. The catalogue is an attractive, well-arranged treatise of 40 pages and contains in addition to illustrations of the different types of equipment and prices, data on torch pressures and consumption.

Small Tools.—A new and comprehensive catalogue describing small tools, including screw plates, taps, dies, drills, reamers, milling cutters, bits, tap and pipe wrenches, pipe vises, etc., which comprise the greater part of its product, has recently been issued by the Greenfield Tap & Die Corporation, Greenfield, Mass. A great deal of information of interest to the user and designer of tools and machinery and some especially instructive tables are also contained therein.

Locomotive Stokers.—The first ten pages of an attractive booklet of 14 pages recently issued by the Locomotive Stoker Company, Pittsburgh, Pa., are devoted to a description of the Duplex stoker and contain clear-cut illustrations which show details of its construction and operation. The remaining pages outline the organization behind the Duplex stoker and include a list of both foreign and domestic railroads using this device.

Pneumatic Tool Accessories.—Air hose, hose couplings, hose clamps, drill chucks, rivet sets and blanks, wire brushes, oils and greases, rail drills, and other accessories for use in connection with Little David pneumatic tools are described and illustrated in Bulletin Form No. 8017, recently issued by the Ingersoll-Rand Company, New York. Tables of dimensions of all rivet sets and chisels are also included.

Packings.—A catalogue, presenting its full line of packings, gaskets and pump valves, is one of the recent publications of the United States Rubber Company, New York. It is fully illustrated and contains definite information regarding each item listed and the specific uses for which it is best fitted, also detailed drawings of construction. A classified index of the different styles of packings sets forth the packings which are recommended for the various conditions of service.

Real Production Tools.—Under the title of "Real Production Tools" the Goddard & Goddard Company, Inc., Detroit, Mich., is distributing a series of pamphlets illustrating and describing some of the tools manufactured by that company. The pamphlets are intended to be largely educational, indicating the lines along which increased production and more accurate work can be obtained in machine shops. The first pamphlet of the series is devoted to the half side mill. The advantages of this form of milling cutter are explained particularly as compared to the standard type side mill with cutting edges on both sides.

Starrett Tools.—A new catalogue that has been issued by the L. S. Starrett Company, Athol, Mass., is not only an improvement in appearance and arrangement over previous catalogues, but contains information about twenty-one new tools. Among the features of especial interest may be mentioned an improvement in the Starrett universal bevel protractor, No. 359; a new No. 24A micrometer caliper gage; new micrometer calipers graduated in millimeters; a new metric fillet or radium gage; a new set (No. 278) of accurate V-clocks and clamps, and a new pair of Starrett firm joint dividers (No. 139).

Freight Cars and Appliances.—The Canadian Car & Foundry Co., Ltd., Montreal, Canada, has recently issued a series of bulletins describing cars built by the company and some of the specialties manufactured in its plant. The numbers of the bulletins and the subjects are as follows: No. 11, Simplex safety brake head; No. 12, A. R. A. standard D coupler; No. 21, box cars for the Canadian Pacific; No. 22, box cars for the Canadian National Railways; No. 23, composite underframe refrigerator cars for the Canadian National; No. 24, all wood stock cars for the Canadian National; No. 31, cars for foreign service.

Wood Construction Information Service.—The National Lumber Manufacturers' Association, Chicago, has recently issued some additional data dealing with mill construction. The subjects treated in these sheets deal with basement floors, roof and roof coverings and include a set of floor beam charts to facilitate the determination of the most economical system of floor construction to carry a given load. Another subject presented is a progress report of tests made by the Forest Products Laboratory, Madison, Wis., in co-operation with the association on built-up beams under various loads in comparison with solid timbers.

Cylinder Regrinding.—A comprehensive, 116-page booklet on "Cylinder Regrinding" has been issued recently by the Heald Machine Company, Worcester, Mass. While this booklet is intended primarily to "assist those entering the business of regrinding automobile cylinders" the cylinder grinding machine illustrated is adapted to many grinding operations in railroad shops. The construction of the machine and many of its possible uses are plainly indicated. There are also several pages of interest to railroad men in showing the advantages of grinding as compared to reaming cylinders. The old idea that abrasive adheres to ground metallic surfaces is shown to be erroneous. The last few pages of the booklet are devoted to special Heald machines including the Styles 80, 85, 70 and 75 internal grinders, the unusually massive cylinder grinder No. 65 and the surface grinder No. 20-22. Heald magnetic chucks are illustrated and described on the last page of the booklet.